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THE SCIENCE TEACHER

Announcing **Winners of Awards for Students and Teachers** *1954*

- Education for a Technological Society
- The Science Teacher Supply—Another Look
- Curriculum Changes for Elementary Science
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- The Appraisal of Natural Resources

JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION


A CHICAGO PUBLIC SCHOOL PHOTOGRAPH

This Month's Cover . . . Three teachers from the East Coast and one from the West Coast share honors in the Third Annual Program of Recognition Awards for Science Teachers. The winners pictured from left to right are: MAURICE BLEIFELD, Elmhurst, N. Y.; EDWARD VICTOR, Newport, R. I.; PHYLLIS BUSCH, Brooklyn, N. Y.; and STANLEY PEARSON, Pasadena, Calif. The awards were presented in April at the banquet meeting of the Annual Convention of NSTA held in Chicago. A detailed report is included in this month's FSA Activities Section.

Readers' Column

Editor's note. We must share with our readers the following excerpts from our exchange of correspondence with one of the winners in the 1954 program of Recognition Awards for Science Teachers.

. . . How does one go about saying in a few words how thrilled he is at being selected for one of the awards? And how does one begin to thank NSTA for the opportunity to win such an award? It's not the monetary gain that matters. It means confirmation that I am on the right track in what I am doing . . . Rogers High School has an endowed science department. The great naturalist, Aggasiz, left us $100,000 in Government bonds, the interest of which is used yearly to buy special equipment. Naturally this helps our teaching . . . I came home (from the Chicago convention) to run into a surprise testimonial banquet, something which has never happened to me before. I was congratulated formally by the City Council and the School Department. I was given publicity in half a dozen New England newspapers. I was asked to speak at Kiwanis and there I was commended by the State Director of Education, and was given a scroll. Just now I have been invited to speak on the "This I Believe" program, sponsored by Edward R. Murrow. Small wonder I have been slow coming down from the clouds!

EDWARD VICTOR
Newport, Rhode Island

Editor's note. Here is a letter which has received more than the usual amount of attention. We found it very interesting and here is the background. The letter came to the Secretary's Office of the NEA and was one of many that were received from Korean teachers expressing appreciation for the generosity of American teachers. The project to send cloth was organized through CARE. Since the Sohns were science teachers the letter was sent to our Department for further action. We were happy to send several sample copies of biology textbooks which we had on hand. Then we sent a copy of the letter to the chairman of the NSTA International Relations Committee for any additional action they may wish to take. It's hard to tell what will happen to some of the letters that arrive each morning in the heavy sacks from the postoffice.

A LETTER OF THANKS

April 21, 1954

To American Teacher

Dear Sir:

How do you do my dear American Teacher?

My father was very glad, for he received cloth you had sent. My father is a teacher of Biology in Agricultural High School of Ulsan. I could have glory to give it to my father. I wrote the letter of thanks to you instead of my father. My father's name is Suh-Bong Sohn. I'm twenty-two year of age. Because I'm the youngest son of educator, I had finished the course of Biology, College of Education, Seoul National University last month (22 March 1954). Now I'm the teacher of Biology in Middle School of Du-Kwang, too.

My father and I want to see Biology textbook that use teacher of Middle and High School and Biology Magazine in American. You want to teach me Biology textbook and magazine price. So I will sent to you the money in American. You have to buy it that will sent to me it in Korea.

I'm very sorry that I'm learning English, I can't write my all words to you. At last I wish you become a John Heinrich Peslozzie.

Goodbye. Waiting for your answer.

Your sincerely, Son of Education,

JIN-MYONG SOHN

Near the Temple of Hanam
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ULSAN GUN, KYONG—NAM
KOREA

THE SCIENCE TEACHER

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OFFICERS OF THE ASSOCIATION

MEMBERSHIP

The membership year coincides with the calendar year. New entries during the fall months extend through the following calendar year. Library and elementary school subscriptions coincide with the school year or run for one year from date of entry.

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* Includes the *Elementary School Science Bulletin* in quantity lots.

Coming . . . .

in the October issue of *The Science Teacher*

- Leonardo da Vinci—Proponent of the Experimental Method
- Recent Developments in Entomology
- Science Interests of Junior High School Students
- Children's Books Enrich Elementary Science

Editor's Column

President Walter S. Lapp is the first of several guest writers whose messages we expect to bring to you during the current school year. Next month our guest will be Dr. Alden H. Emery, Executive Secretary of the American Chemical Society. *Editor.*

THINKING ABOUT THINKING

In the Commerce Building in Washington, D. C. a huge speedometer-like device records the increase in the population of the United States as five per minute. In a day the increase is 7,200 and in a year it is about 2½ million. Eventually these newcomers will need jobs—jobs that now do not exist. People with imagination will have to create these jobs.

An advertisement in the July 25th issue of THE NEW YORK TIMES stated *"Arma's plans call for highly creative approaches to unexplored challenging problems."* Industry everywhere is looking for men who can think creatively. Progress depends upon research and research depends upon thinking. This applies to literature, art, music and to all lines of human endeavor. Many methods are used by scientists. They all include observation and experiment, followed by the classification and correlation of facts, which in turn lead to new ideas.

May I suggest that as science teachers we do some thinking about thinking. Let us present historical episodes in science as case histories of creative thinking. One of the functions of all teachers is to detect and encourage talent. Everyone has the faculty of creative thinking to a certain degree. Let us develop it to its natural limit. Don't let the big ones get away. The world would be far different if Sir Humphry Davy had not discovered Michael Faraday, whose crowning achievement was the discovery of the relation between electric currents and magnetism.

Let me suggest that the time is at hand when science teachers should make an effort to teach creativity deliberately. In every science club and classroom we can set up an idea shop. To get started one might refer to two articles in recent issues of THE READERS DIGEST (Elliott R. Danzig, *To Solve That Problem*, July 1954, p. 128; Gilbert Highet, *Man's Unconquerable Mind*, August 1954, p. 151). The Osborn book contains over 200 additional references. Surely here is a challenge to every science teacher of any grade level or subject matter field.

Walter S. Lapp

President

THE SCIENCE TEACHER

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The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

Education for a Technological Society

By AGNES E. MEYER

IT is with great humility that I venture to address a group of scientists. If I attended some of your meetings, I fear I would not even understand what was being said. But there is nevertheless a strong bond between us. For as a life-long pupil of John Dewey, I have labored to use a scientific approach to the solution of many social problems. And it is not impossible that this endeavor is a far more dangerous enterprise than yours in a period when emotion is stronger than reason and the instinct to conform has weakened our love of liberty. For the natural sciences after a prolonged battle in which many great men have sacrificed their lives, have at last won the right to the unimpeded search for truth. But the social scientists are still suspect —never more so than now that the public has been bamboozled into thinking that our educational system is riddled with socialists and communists. Indeed I, myself, am the bearer of several honorable wounds because I have maintained and acted upon the conviction that the social scientists must be granted the same freedom of research, the same freedom of teaching and the same freedom of speech as the natural scientists.

But let us be of good cheer. The common sense of the American people is reasserting itself. The fears which have dominated this country are beginning to recede and the voice of reason is once more gaining ascendency.

But let us not deceive ourselves. This great nation of ours that used to be considered the last best hope of men, has lost much of the respect it once enjoyed among civilized people, not so much through the machinations of our powerful adversary, communism, but through our own weak submission for years to a cheap political adventurer. The only way of restoring the true character of America, is through a solemn rededication of ourselves to the nation's welfare and to the numerous problems both domestic and international which were forgotten and neglected while government officials, Senators, and most of our civilian leaders behaved like a lot of rabbits in the presence of a cobra.

There is but one fundamental defense against the communist menace. The American people must prove that democracy is mankind's only hope for the good life by making faster progress toward the realization of our democratic principles and values here at home. As was stated recently in the *Progressive Magazine* after a factual review of Senator McCarthy's disreputable career, we must "replace the Big Lie of Communism and McCarthyism" with "The Big Truth" of a working democracy. If we now devote ourselves unselfishly to this task, we shall send waves of hope and confidence throughout the world. For any effort to strengthen our democratic principles here at home, however local and modest, points with irrefutable logic to their universal application. Seen in this light, public service to the community acquires a new and deeper significance. It becomes not only a question of social justice or of individual welfare; it will develop the moral force of democracy, the force of a free people acting together for the common good—the only force to which communism has no answer.

Therefore, I welcome as most timely this opportunity to discuss with you a problem that is as close

to your hearts and interests as it is to mine—the role of education in our complex technological society, a role so vital and in many ways so new that the American people as a whole do not realize as yet that the future of our country and of western civilization depends upon the expansion and improvement of that unique institution, our public school system.

The Duke of Wellington after the Battle of Waterloo said that this victory which saved Europe from Napoleon's domination, was won on the playing fields of Eton. I say to you, my friends, that the freedom of the western world will be lost or preserved in the classrooms of our public schools. That is the main reason why our schools have become such a storm center in this revolutionary era. The Americans who have become afraid of freedom are attacking our schools in order to curtail human liberty. Other Americans who love freedom as the very life of our democracy, also criticize the public school system because they know its weaknesses and wish to improve it. Everywhere in the United States today, education is the subject of controversy. The teachers and administrators are buffeted by conflicting winds of pressure and prejudice. These are largely repercussions of the antagonisms created by our Congressional Inquisitors, one of the many evil effects of McCarthyism. How then are we to allay these storms and unite the American people in a constructive program to fortify our educational system without further waste of time and energy?

We must try to simplify a complex problem by focussing the attention of the American people on the acute need of our country for all of its potential talents, especially its need for scientific and professional manpower. This nation's economic, social, and moral well-being and its world leadership now depend upon our ability to organize society in such a way that it will develop rather than hamper the well-being of humanity. This is the most stupendous responsibility ever placed upon a single nation. The tense world situation gives our resources of trained personnel a special significance; our national security and the strengthening of the free world will depend largely upon the leadership of many different kinds of scientists and professional experts in nuclear physics, aeronautical engineering, agriculture, diplomacy, psychology, anthropology, and numerous other fields. In short, our primary concern today must be in the development of the skills, capacities, and creative imagination of the American people. There lies the greatest contribution we can make to the future of mankind.

Yet this necessary emphasis of the importance of science to society meets with powerful opposition today from various reactionary forces. The all-prevailing hostility to freedom of thought, of reason, and inquiry has resulted in an attack upon public education in general but particularly to scientific education as the source of our so-called "materialism" and "secularism". We are admonished that we must become more "spiritual" by renouncing science for the liberal arts and The Hundred Best Books if America is to save its soul. It does not occur to these confused mentalities that they are trying to turn back the tides of civilization, and that the enrichment of life, of consciousness, and of the imagination with the significance of scientific insights leads to a deeper understanding of life, or spirituality if you will, than vicarious experience of life-through-literature. To be sure there are overly-narrow scientists as there are narrow members in every profession. Over-specialization is a real danger to the development of balanced personalities. But that does not change the fact that scientific knowledge is the key to our survival as a free nation, as well as to our social progress and moral development. Personally I feel that our leading scientists with their passionate devotion to the pursuit of truth are the saints of the modern era for their lives are dedicated to human welfare and are, therefore, spiritual in the highest sense of the term.

The acute shortage of trained man-power in every area for scientific research, for military defense, for engineering, medicine, nursing, chemistry, teaching, and industry, has been thoroughly explored by the members of the National Manpower Council. They state that an adequate supply of scientifically and professionally trained personnel can be attained only by a large-scale concerted effort by various groups and institutions. *But central to this whole endeavor is the necessity of maintaining good elementary and secondary schools.* To be sure, the field of higher learning also receives the attention of the Manpower Council, but it is clear that the supply of high-grade talent in our colleges and universities will dry up if we do not improve the educational standards in the public schools.

Yet those average standards have been going steadily downward as even the best friends of the public schools will admit. The reasons are manifold but two stand out above all others—the shortages of trained teachers and of class-rooms—a desperate situation which a people more alert to the importance of education should have foreseen and forestalled.

In order not to burden you with too many sta-

In only two years a "science and public affairs" type address has become an outstanding feature of NSTA's conventions. At the Chicago convention we were indeed fortunate to have one of America's foremost thinkers and best-known public speakers, Agnes E. Meyer of Washington, D. C. Herewith is a ninety per cent condensation of her stimulating address.

The wife of the chairman of the Board of the *Washington Post and Times Herald,* Mrs. Meyer devotes much of her time and energies to study, discussion, writing, and action programs directed toward critical social problems and issues. Among these, none is considered by Mrs. Meyer to have greater significance or to play a more vital role in American life than public education. She is, in her own words, "a passionate defender of our public schools, and wholly devoted to their improvement, expansion, and readjustment to new social demands."

Born in New York City, Agnes Meyer lived her childhood days in Pelham Heights; later graduated from Morris High School in New York City and took her baccalaureate degree from Barnard College. Her autobiography, *Out of These Roots* (Little, Brown and Company) was recently awarded the bi-annual $1.000 award from Delta Kappa Gamma for writing in education.

tistics, I shall confine this discussion to the situation in our high schools and particularly as it affects the study of science.

It can be accurately predicted that owing to our post-war birthrate high-school enrollments will shoot from the present figure of 6 million to 9 million by 1960 and 11 million by 1966. This represents an enormous pool of human potentialities. There lies the real wealth of our country. The high-school years are crucial to every child for those are the years of decision when the most careful teaching and guidance are needed if we are not to waste, as we do now, about a half of the talented youngsters who could be excellent college material. Yet so indifferent have we been to the nurture of our human resources that even now the 340,000 teachers are not able to staff the high schools properly. Yet within six years we shall need about 80,000 more high school teachers. If we narrow this down to the need for science teachers, we must recruit about 7000 more every year. This demand, including replacements as well as new positions, will soon go to 10,000 a year.

These figures are of course based upon the need to teach only the formal classes in science, not upon the fact that every high school student, if we Americans are to direct our common problems with intelligence, should be educated with a view to using the methods exemplified in science for the daily conduct of life.

In the face of a universal need for scientific education, the supply of adequately trained teachers is drying up. The figures which the Research Division of National Education Association has just given us for this coming June are even more alarming.[1] Only 259 students will graduate with qualifications that will enable them to teach physics, 608 in chemistry, 1606 in biology, and 1505 in general science. With less than a total of 4000 science teachers only 40% or 1600 will actually enter the teaching profession. Unless a joint effort is made to encourage young people to become science teachers, the technological development and leadership of our country is jeopardized.

Considering the meager financial rewards for teaching, I often wonder why anyone goes into it, especially in periods of prosperity when the beginning salaries for trained people in industry are higher than the top salary a teacher can expect after years of service. Last year the average income of all teachers was $3530. Though increases have been granted in the last few years, they have not kept pace with the cost of living. In 1938 teachers were in the top third of the income level; by 1948 they had dropped to the bottom third.

Now I know the argument that increased salaries are not the whole answer to the problem of teacher recruitment. *But it is undoubtedly the best single answer, for otherwise so many science teachers would not be lost to industry.* It is essential moreover that we recruit more able men for the teaching profession and that can never be achieved at the present salary schedule. It is of profound consequence to our cultural development, especially now that our public schools are forced to take over many of the functions normally performed by the home, that our public school personnel should not be over-feminized. Never will the teaching profession regain the status and dignity it once enjoyed in our society as long as it remains so predominantly an occupation for women. In saying that I show no disrespect for the intellectual accomplishments of my sex. But it stands to reason that woman's chief objective must be marriage and the rearing of a family. It is common knowledge that many young girls look upon teaching as a stop-gap between graduation from college and the finding of a suitable mate. This is largely responsible for the enormous annual turnover among teachers. It makes for instability in the profession and for a derogatory attitude toward it. Quite apart from the fact that our boys and girls are in need of the masculine influence which is only too frequently absent in family life today, we must achieve a better proportion between men and women in the teaching profession if the general public is to give it the respect it should have and thus attract not only men but

[1] See the article by Ray Maul on page 172.

also women of the highest character and intelligence. To be sure it will be costly to adjust the salary structure of the teaching profession to a point where it can compete with the rewards in other professions. But it is unrealistic to think that our public schools can perform their vital function in our technological society, in the daily life of the local community, and in the maintenance of a free world unless we are willing to pay the price for a first rate teaching personnel.

What's more, Beardsley Rumel, a tax expert, has just stated at the annual meeting of the National Citizens Commission for the Public Schools that *we can afford to pay the price*. As a matter of fact, Americans will pay the price if only they are made to understand that the security of our nation and the whole free world is at stake. Testifying seven years ago before a congressional committee in favor of Federal aid to education I put the matter this way: "When our nation is threatened by the Communist promises of greater equality among people, however specious such promises may be, it is defeatism to say that we cannot afford to give every American child a fair start in life. Money is flowing like the Mississippi now that the military might of Russia threatens us with another war. Well, education is also a war, a war against poverty, ignorance, and despair, a battle to lift the whole cultural level of the nation and prepare it for the heavy international responsibility it can no longer escape. It is the only constructive war any nation can wage. Economizing on education is national suicide. The question is not whether we can afford so much education but whether we can afford so little. Twice two certainly makes four as our budgeteers remind us. But when we begin to economize on education, it can also make catastrophe."

Now, my friends, I haven't come here today just to moan and groan about this situation but to tell you what I think can be done about it. Let us quickly review the dire need for class-rooms. The college presidents are complaining that the students sent them from our highschools can't read, write, or spell. Well I'd like to see Mr. Arthur Bestor conduct an over-crowded class of 40 to 60 pupils that range from the subnormal child to the average and the bright with a few delinquents thrown in for good measure by the juvenile court. I have just completed a community-wide study of juvenile crime which proves that children who move from a broken home to an over-crowded classroom have very little chance to keep out of trouble. And when they get into the hands of the law, God help them. In other words, our over-crowded schools are largely responsible for our appalling rate of juvenile crime. At the same time the armed forces are complaining that the Selective Service had to reject 3 out of every 10 men for educational or physical deficiencies that could have been avoided by a really adequate school system.

The U. S. Office of Education has just issued a report about the shortage of school buildings. As of September 2, 1952 the total school construction need was estimated at 312,000 class-rooms at a cost of 10.6 billions. The report estimates that local school districts together with State aid now available could provide 5.9 billion, leaving a deficit of 4.7 billion.

Where is this deficit to come from if not from the Federal Government? In his last State of the Union message President Eisenhower said: "Youth —our greatest resource—is being seriously neglected in a vital respect. The nation as a whole is not preparing teachers or building schools fast enough to keep up with the increase in our population." A year ago he said: "Our school system demands some prompt, effective help". Yet all the Administration has done about this acute problem is to recommend State conferences culminating in a White House Conference on Education some time in 1956. By that time enrollments will snow-ball, hundreds of old schools will be obsolete, and our class-rooms will look like cattle-yards.

The horrible tragedy which has just taken place in a public school near Buffalo should be a warning to the Administration that possible assistance to the States two years hence is no answer to this problem. Ten children lost their lives and many more were seriously burned in the school's one-story wooden annex by a sudden explosion of coal gas from an old-fashioned furnace. Due to the sudden influx of students in our public schools many flimsy structures have been erected, and thousands of other antiquated schools are equally unsafe. Eighteen percent of all of the elementary and secondary students are housed in fire-traps that do not meet the minimum safety standards. We are bound to have even more such terrible catastrophes if the States and localities are obliged to wait indefinitely for financial assistance from the Federal Government to accelerate the tremendous effort they are making to construct new fire-proof schools.

The Administration excuses this shameful delay of any constructive action by saying we must first know what the States and localities can do. Well since 1951 the States and localities appropriated more than a billion dollars every year and last year they spent the huge sum of 2 billion dollars on

school construction. Many localities have reached the limit of their taxing ability—and yet the appalling deficit of 4.7 billion, as Commissioner Brownell has pointed out to the Administration, represents the sum which the States cannot meet.

Another excuse which the Administration offers is the cost of its welfare program for hospitals, clinics, health rehabilitation, and so forth. That is a lop-sided program since these bills are all remedial. Now I am the last person who can be accused of indifference to protection of the aged, the sick, the handicapped—I have worked hard on all those programs for many a long year. But I maintain that if all of our efforts are to be expended on the weak, while we neglect the strong, the talented, and creative people, we shall soon become not a welfare state but a hospital state in which the productive citizens will have to bend their backs to take care of the unproductive.

Therefore for the past few months I explored the sentiment of Congress on the subject of Federal aid for school construction. I confined my inquiries to this one aspect of our educational needs because it is a tactical error to demand too much from my economy-minded fellow Republicans. I found both Democrats and Republicans eager to do something at once. In fact several bills have already been drawn by members of both parties for Federal aid for school construction. When I suggested to members of both parties that they get together and draw up a bi-partisan bill, this, too, was received with unexpected enthusiasm. In fact this legislation of Federal aid for school construction is probably the only field in which both parties would be willing to cooperate. The mutual party resentment generated by the coming election has been so disturbing to the average American that bi-partisan action in any area would certainly have great psychological value. Moreover, if the recession should become more acute, no public works program could be economically more sound or more generally beneficial than Federal aid for the construction of public-school buildings. It would reach every section of the country and stimulate both light and heavy industry as well as transportation.

Therefore my friends if you will present these various arguments to your Senators and Congressmen for hastening such a legislative program, I am sure you would find them receptive. You should also get your school board members, your P.T.A., and all other school organizations to address letters and telegrams to this effect to Mrs. Hobby, Secretary of Health, Education, and Welfare, and to Governor Adams, Assistant to the President. Tell them a mere token assistance for school construction is useless. We need 500 millions as a minimum to be followed by larger appropriations for the next few years. After all, a large-scale Federal construction program can be a short-term affair. If we break the stranglehold of current needs, within a few years the States and localities can plan to provide for all future enrollments. Moreover, if we remove some of the financial burden of school construction, the States and localities will be able to increase teachers' salaries and attract more and abler young people into the teaching profession. In fact the Federal aid bill can and should be drawn in such a way as to encourage State participation and State contributions for educational progress.

We haven't much time left, if we are to get such a bill passed at this Congressional session. But the Administration is having difficulty with its own welfare proposals. The housing bill has already been scuttled. The only other bill in the Administration's program that has wide appeal is the one that expands the Social Security program, and even that highly necessary measure will call for long and intricate hearings. The Republican Administration could do nothing with more popular appeal, nothing that would enlist the sympathies of the woman and the average non-political citizens who gave President Eisenhower his overwhelming majority than a bill for Federal aid to the States in this crushing burden of school construction.

We have only to make it clear to the Administration—and there you scientists with your knowledge of the facts and your sense of reality can be of tremendous influence, that we must have better schools—and that their improvement cannot wait without doing irreparable harm to millions of America's children. The conscience of the nation must now assert itself if we are going to train the kind of citizens—the leaders of tomorrow who can carry the appalling responsibilities confronting our nation. Many Americans now feel frustrated because they think they can do nothing as individuals to stave off the menace of communism. I say to you—increase the self-respect of every community by improving its public schools, make America a free, just, and efficient democracy in every city, village, and hamlet—and nothing can defeat us. With courage and a positive faith in democracy implemented through action, we can build a happier future for mankind than any this world has yet experienced.

THE SCIENCE TEACHER SUPPLY—

Another Look

By RAY C. MAUL

Assistant Director, Research Division, National Education Association

The facts behind science teacher supply and demand are reported again by a man who has given them a careful study. You may wish to review Dr. Maul's article, "Wanted: Science Teachers for Tomorrow", in which he gave us a first look. (THE SCIENCE TEACHER, *September 1953)*

IF IN FOUR YEARS we reduce by one half the supply of qualified teaching candidates coming from the colleges, can we provide the instructors needed in the high schools of America? This is exactly the situation we are facing in the science field today. In fact, the 1954 report from all institutions training teachers shows a drop of 56.3 percent from the number of eligible science teaching candidates in the 1950 class.

A second side of this problem shows that we must reconcile ourselves to a continuance of this decrease for at least two more years; the college graduating classes of 1955 and 1956 will be the smallest in recent years.

Third, only one half (53.3 percent) of the college graduates eligible to enter teaching actually do so; just over one third (38.2 percent) of those prepared to teach the science courses accept employment as high school teachers.

A fourth factor to be reckoned with is the oncoming avalanche of students who will push into the high school classrooms in the immediate future. It is not enough to replace those who leave the classroom for all reasons; classroom teachers must be added as the enrollment expands.

Future Outlook Cause for Concern

The foregoing facts, tersely stated, are only the highlights of the rapid changes now enveloping the American high school system. Some of the details, as revealed by the Seventh Annual National Teacher Supply and Demand Report,[1] should cause us to pause and re-evaluate our plans to meet present and future responsibilities.

It is easy to see that a continuance of present trends will inevitably lead to serious trouble. The quality of the instructional program—of which the classroom teacher is the very heart—will be threatened the minute it becomes necessary to resort to emergency measures. The effective teaching of science is not only intimately related to the formal qualifications of the teacher (his academic and professional preparation); teaching results are measured most severely by the enthusiasm, the drive, the professional zeal, and the insights which enable the teacher to lift the student to the highest level of interest and endeavor. If and whenever we exhaust the supply of such persons to staff our high schools, we permit the foundations of our free public educational system to decay. It is not just a case of numbers; it is primarily a case of service at the highest professional level.

Certainly this is true in science, because the science teacher has a peculiar responsibility to our whole society. In a meaningful way he holds the key to the place America will assume among the nations of the earth. The high school teacher of science will identify and inspire the high-potential science student in numbers sufficient for our future needs in a world society dominated by science—or America will fall behind in the international race. This statement is not an oversimplification; the high school science teacher actually has a vital relation to our future progress.

True, there are in each generation of our youth many superior students. Some have exceptional talents in a particular field; many are capable of high achievement in broad areas of learning. Some of these superior students enter high school with occupational choices already made. Most of them, of course, are influenced by the counsel of parents and friends. It is important to note, however, that many parents of students of *high scientific potential* have not had formal training in science themselves and thus (a) do not know how to evaluate the young person's talents, (b) do not appreciate the fundamental role of science in present day society, and

[1] The study is conducted annually and the report prepared by the NEA Research Division; it is published by the NEA Commission on Teacher Education and Professional Standards in the March issue of the *Journal of Teacher Education*.

(c) do not appreciate the significance of the advanced training now necessary to enter the higher levels of professional service.

Here is where the high school science teacher comes to the front. The classroom teacher can quickly recognize and evaluate the innate capacity of the student, and, moreover, *the teacher can spark the latent interest* of the student to whom many different challenges rise and subside from day to day. Above all, the period of high school attendance is the optimum time to lead the student to recognize the rewards available to him through continued formal study. Specifially, the high school science teacher not only can, but *must* seek out and encourage the young students with scientific bent.

In the world-wide struggle of ideologies, which threatens to extend on into the indefinite future, we need not fear that we of the Western World will be subdued because we are so badly outnumbered *if* we set about to make fuller use of our potential. This means, specifically, that we must identify and train for the higher levels of service (certainly including high school science teaching), a much higher percent of the superior youth of each generation than we are now doing.

The Question of Numbers Will Not Down

Now we must go back and examine the question of numbers briefly mentioned in the opening paragraphs. The most imperative need at the moment is for *more* qualified, competent candidates for high school science teaching. The present down-trend in the supply threatens to force the high schools to an emergency basis because the number of new candidates to come from the colleges is dwindling to the vanishing point.

Table 1 shows the most recent four-year trend. In 1950, almost 87,000 graduates met the certificate requirements to enter high school teaching; of this number some 9100 had major training in at least one of the science fields. In the four years between 1950 and 1954 the number of college graduates trained for high school teaching has decreased 41.7 percent—*but the number prepared to teach science has fallen 56.3 percent!* It is also shown in Table 1 that the number of eligible candidates for the teaching of mathematics has been cut squarely in half since 1950.

Does this mean that there is a decreasing proportion of college students interested in science? Not at all. It does mean, however, that there has been an abrupt shift away from preparation for teaching this subject. In all phases of our industrial and professional life there has been, and continues to be, a demand for science trained college graduates far beyond the total number produced. This sharpened competition since 1950 has siphoned off many who would otherwise have prepared for teaching. The ominous threat to the high school program would be less serious if a slackening of this competition could be foreseen. Unfortunately for teaching, no such relief can be anticipated for perhaps a decade. In another ten years there will be a substantially larger group coming to maturity annually. Even then, the percent who will prepare to teach will be determined by factors yet to emerge. Meanwhile, the plight of the high school will grow more serious.

Where Do the Qualified Candidates Go?

But how effective is the teaching profession in obtaining the services of this diminishing supply coming annually from the college graduating classes? The answer to this question is not encouraging, as shown in Table 2. Recently assembled evidence shows clearly that the classroom attracted just over one half (only 53.3 percent) of the members of the 1953 class who were prepared to teach in high school. Here, again, science teaching was at the greatest disadvantage, with only 38.2 percent of the eligible candidates appearing in the classroom as teachers. Science students pursuing a combination major (potential general science teachers) led with 43.7 percent actually becoming teachers; followed by biology majors, 38.7 percent; then physics majors, 38.6 percent; but with only 26.9 percent of the chemistry majors accepting teaching positions.

The loss of potential chemistry teachers is clearly shown in Table 2, with 19.9 percent entering other types of employment, 21.5 percent choosing to continue with formal study, and 24.2 percent entering military service. It is possible, of course, that these latter two groups (including more than two of every five chemistry majors prepared for teaching) contain a good many persons who will later enter teaching. Those pursuing graduate studies will probably look to the college classroom for teaching employment, however, and will thus contribute little to the needed high school supply.

Of the potential physics teachers 14.7 percent took nonteaching jobs, 16.0 percent went on for graduate study, and 22.7 percent entered military service. Of those prepared to teach biology 9.8 percent entered other employment, 13.1 percent continued formal study, and 24.4 percent joined the military forces. Of the potential teachers of general science 9.1 percent took other jobs, 10.0 percent continued study, and 17.3 percent entered military service.

TABLE 1.—TOTAL NUMBER OF COLLEGE GRADUATES; TOTAL NUMBER PREPARED
TOTAL NUMBER PREPARED TO TEACH

Year	Total bachelor's degree candidates		Total graduates prepared to teach in high school		Total graduates prepared to teach mathematics	
	Number	Percent change from 1950	Number	Percent change from 1950	Number	Percent change from 1950
1	2	3	4	5	6	7
1950	433,734	....	86,890	....	4,618	....
1951	384,352	−11.4%	73,015	−16.0%	4,118	−10.8%
1952	331,924	−23.5	61,510	−29.2	3,142	−32.0
1953	304,857	−29.7	54,013	−37.8	2,573	−44.3
1954	285,000[a]	−34.4[b]	50,624	−41.7	2,281	−50.6

[a] Estimate. [b] Calculated on estimate.

TABLE 2.—OCCUPATION, ON NOVEMBER 1, 1953, OF ALL MEMBERS OF THE 1953
BASED ON REPORTS FROM ALL COLL

Field of preparation	Teaching		Otherwise employed		Continuing study	
	Number	Percent	Number	Percent	Number	Percent
1	2	3	4	5	6	7
Total of all high school subjects:						
Men	2,914	43.0%	629	9.3%	690	10.2%
Women	3,533	66.4	415	7.8	234	4.4
Total	6,447	53.3	1,044	8.6	924	7.6
Mathematics:						
Men	165	39.3	37	8.8	42	10.0
Women	111	64.1	19	11.0	11	6.3
Total	276	46.6	56	9.4	53	8.9
General science:						
Men	111	41.0	24	8.8	30	11.1
Women	38	54.3	7	10.0	4	5.7
Total	149	43.7	31	9.1	34	10.0
Biology:						
Men	83	33.8	21	8.5	36	14.6
Women	47	52.2	12	13.3	8	8.9
Total	130	38.7	33	9.8	44	13.1
Chemistry:						
Men	37	24.2	27	17.6	32	20.9
Women	13	39.4	10	30.3	8	24.2
Total	50	26.9	37	19.9	40	21.5
Physics:						
Men	29	39.1	11	14.9	11	14.9
Women	0	0.0	0	0.0	1	100.0
Total	29	38.6	11	14.7	12	60.0
Total sciences:						
Men	260	34.9	83	11.2	109	14.7
Women	98	50.5	29	15.0	21	10.8
Total	358	38.2	112	11.9	130	13.9

[1] Connecticut, Illinois, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nevada, New Mexico, Utah, Vermont, Wisconsin, and Wyoming.

TO TEACH IN HIGH SCHOOL; TOTAL NUMBER PREPARED TO TEACH MATHEMATICS; SCIENCE; PERCENT CHANGE SINCE 1950

Total graduates prepared to teach a science					
General science	Biology	Chemistry	Physics	Total science	
Number	Number	Number	Number	Number	Percent change from 1950
8	9	10	11	12	13
3,009	3,473	1,660	954	9,096	....
2,772	2,815	1,342	578	7,507	−17.5%
2,216	1,995	842	373	5,426	−40.3
1,664	1,698	662	357	4,381	−51.8
1,505	1,606	608	259	3,978	−56.3

COLLEGE GRADUATING CLASS WHO WERE PREPARED TO TEACH IN HIGH SCHOOL, EGES IN 13 STATES AND HAWAII [1]

Military service		Homemaking		Seeking employment		No information		Total	
Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
8	9	10	11	12	13	14	15	16	17
1,508	22.2%	0	0.0%	55	0.8%	985	14.5%	6,781	100.0%
11	0.2	382	7.2	57	1.0	692	13.0	5,324	100.0
1,519	12.5	382	3.2	112	0.9	1,677	13.9	12,105	100.0
119	28.3	0	0.0	3	0.7	54	12.9	420	100.0
0	0.0	14	8.1	3	1.8	15	8.7	173	100.0
119	20.1	14	2.4	6	1.0	69	11.6	593	100.0
47	17.3	0	0.0	2	0.8	57	21.0	271	100.0
0	0.0	6	8.6	0	0.0	15	21.4	70	100.0
47	13.8	6	1.7	2	0.6	72	21.1	341	100.0
60	24.4	0	0.0	2	0.8	44	17.9	246	100.0
0	0.0	6	6.7	1	1.1	16	17.8	90	100.0
60	17.9	6	1.8	3	0.9	60	17.8	336	100.0
45	29.4	0	0.0	0	0.0	12	7.9	153	100.0
0	0.0	2	6.1	0	0.0	0	0.0	33	100.0
45	24.2	2	1.1	0	0.0	12	6.4	186	100.0
17	23.0	0	0.0	0	0.0	6	8.1	74	100.0
0	0.0	0	0.0	0	0.0	0	0.0	1	100.0
17	22.7	0	0.0	0	0.0	6	8.0	75	100.0
169	22.7	0	0.0	4	0.5	119	16.0	744	100.0
0	0.0	14	7.2	1	0.5	31	16.0	194	100.0
169	18.0	14	1.5	5	0.5	150	16.0	938	100.0

It is significant that these defections are greater in each of the groups of potential science teachers than are the losses when all potential high school teachers are considered together. On the average 8.6 percent entered nonteaching employment, 7.6 percent continued formal study, and 12.5 percent went to the military service.

Every Teacher a Counselor

The foregoing is a gloomy picture of things to come if present trends continue. The way is open, however, for substantial relief before the situation becomes critical. But the active help of every classroom teacher is needed.

Many teachers, in fact most teachers, quickly establish and then maintain a cordial, informal counseling relationship with their students. Perhaps one of the criteria of effective teaching is the readiness of students to seek the guidance of the teacher in important personal questions outside the subject being studied. This warm response of students—this desire to share with the teacher the unsolved problem of future vocation—is one of the rewards of teaching. In this area the teacher may make a most meaningful contribution to the future life of the student.[2] Science teachers now in service are, of course, appreciative of this fact. We can only urge that such efforts (which always lead to the discovery of students not only with ability, but with interest in science) be redoubled.

There are really only two sources from which a larger supply of scientifically trained personnel may come. More of the students already bound for college, for example, may be encouraged to explore their innate talents, and eventually to choose some phase of the sciences as a field of concentration. Any increment thus gained is, after all, at the expense of some other area of learning. Teachers of any subject are likely to try to influence their strongest students to choose that subject. At the college level, particularly, this does no more than to sharpen the competition for a constant number of students. Certainly the beginning college student needs the wisest counsel, based upon the fullest and most up-to-date information about the number and the nature of vocational opportunities, before making a final choice and investing years in preparation for that choice. Such counsel, to be most valuable to the student, must be above the level of vested interest in any one field.

But the high school teacher is at home with—literally in the midst of—the second, and much larger source of supply. The greatest loss (to society) is that high intelligence group of youth who are lost *between the seventh grade and entrance to college*. The public school system has not yet attained 50 percent efficiency in delivering for post-high school study the cream of each generation. Actually, a larger number of high potential science students—the type from whom major contributions might rightly be expected—never enter college than the number who do. At no time in the past has more than one third of the highest 20 percent in intelligence carried through to college graduation.

Here is a field worthy of more intensive cultivation. This work must be done in the local school and with the individual student. The encouragement of more of our superior youth will strengthen all fields, but not any one at the expense of others. A sharper lookout for the student with high promise in science is the peculiar obligation—and opportunity—of every science teacher. More than the parents, the principal, the guidance director—more than anybody else—the science teacher can identify the student's potential abilities.

[2] Two helpful publications for the science teacher-counselor are now available from the National Science Teachers Association: *Encouraging Future Scientists: Materials and Services Available 1954-55* (50 cents), and *Encouraging Future Scientists: Student Projects* (50 cents). A third publication dealing with Careers in Science Teaching is now in preparation. Announcement of publication date will be made in THE SCIENCE TEACHER and distribution will be free in limited quantities.

Elementary School Science

CURRICULUM CHANGES NEEDED BECAUSE OF OUR TIMES

By HANOR A. WEBB

An address to the Elementary Science Section, NSTA, Second National Convention, Chicago, April 3, 1954. Dr. Webb is Professor of Science Education, Emeritus, George Peabody College for Teachers, Nashville, Tennessee.

TWO WORDS IN MY TITLE should be defined—"our times". The synonym may be the *status quo,* an apt though shocking translation of which has been "the mess we're in!"

We are indeed in a whirl and swirl of events that can not be ignored. The maxim, "Nothing is changeless except change," applies to everything that is a force or consequence of nature. On the face of the earth—erosion, upbuilding. Of plants and animals—the emergence, development, extinction of species. Even the mores of our social customs—skirted and stockinged ladies on the bathing beaches of Chicago in my student days 45 years ago, while last summer . . . I could tell more and more about less and less!

How fundamental have these changes been?

Do the principles of science change? Fundamentally, no. There are notable new discoveries—Einstein established a new physics—Lawrence and others have made eight new chemical elements. Such aspects of progress, often far too technical to explain in the grades, ultimately have implications that we can explain. Einstein's formulas of 1905 and 1915 are the foundations of the atomic bomb—which we *do* discuss with the little folks, with such interpretation as seems wise.

Does the human mind change? Fundamentally, no. Ancient and modern philosophies of learning and conduct have much in common. New knowledge, however, brings new lessons to be learned. In geography the idea of a flat earth contended for centuries with that of a round earth, but truth finally overcame error. In medicine Pasteur's "theory" about germs has now become a "fact." In physics Mme. Curie upset the concept of changeless atoms, letting the Atomic Age begin a half-century later. In chemistry we now have polymers and plastics that modify all former diagrams of molecular architecture. Yet with all such modern understandings to guide our thinking, Aristotle and Plato are still worth reading.

Do human needs change? Fundamentally, no. Food, clothing, and shelter are still basic for the body. The stimulus of employment and the relaxation of entertainment are still necessities of the mind. Faith and hope—the more sincere the better—still nourish the soul.

What, then, does change? What, in comparison to "other times," does "our times" imply?

It should be obvious by now that I minimize the need for changes in our elementary curriculum merely because of "our times." I am a conservative, though not—I hope—a fossil. If I were an extreme conservative I might sing lustily . . . .[1]

"The old-time curriculum
  It's good enough for me!
'Twas good for my father
  'Twas good for my grandpaw
'Twas good for great-grandpappy
  It's good enough for me!"

Our present curriculum is by no means the "old-time" one, for changes have been continuous through study and experience. Noteworthy has been the increasing study of natural science at all levels. I am not aware of any crucial unworthiness of our present methods of teaching in the grades. I might create a sensation by originating some explosive reorganization of the present curriculum. But whereas I could urge revolution, I suggest evolution.

This moderate and continuous development will be an adjustment to certain changes that *should* affect our teaching in the grades. Four of these seem significant:

1. *Our ways of doing things change.* The great assemblies of the Scholastics in the Thirteenth Century may be compared in spirit to these National Science Teachers conventions—but what a difference in the topics for discussion! Selecting a shorter span, the lessons I taught about textiles in the

[1] Prof. Webb may have set a precedent for singing during an NSTA address. Who will try it next?

Naughty 'Oughties have required extensive revision in the Fabulous 'Fifties to include the amazing synthetic fibers. Would Faraday's *Chemical History of a Candle* enthuse and inspire a student under a fluorescent lamp?

Commercial airplanes now fly from coast to coast in one sunlit day. Class discussion ensues: How so fast? Why so fast? Whose hurry?

Such modifications as these have become topics of instruction because we do things differently. These topics will get into published curricula in due time. The alert teacher, however, will not wait, but will give daily attention to what is new, is important, and may be incorporated into a lesson. There is no substitute for this alertness!

2. *The tools of daily living change.* The study of transportation once glamorized steam locomotives; today the prosaic internal combustion engine that powers rail diesels, autos, ships, and planes is our lesson. The steam locomotive will disappear from our texts, as jet power comes in.

The amazing electronic devices now spread their services from radios to "electric brains." These may be observed at lower levels, experimented with at higher levels, explained at upper levels. No teacher of today can escape electronics.

What practical lessons in the grades are suggested by the automatic laundry, the power mower, the room cooler found in so many suburban homes?

A new hobby sweeps the land (as African violets), and new activities in a classroom develop. New treatments in medicine (as the current polio inoculations) challenge teachers to simple explanations.

All this emphasizes the good teacher's formula for today's good lesson—keep up with what is going on!

3. *Our list of useful words expands.* Every new invention or process brings an array of terms with it. These are necessary for the workers'—and indeed the public's—intelligent comments about it. The automobile brought *garage, fluid drive, hydramatic,* and many other words——including *hot-rod* —in its trail. The airplane has recently presented *jet* and *supersonic* for definition. The lingo of the photographer, the gardener, the radio announcer, the canasta player becomes a necessity for informed conversation.

Vocabulary enrichment is a major responsibility of all teaching at all levels. This rests heavily during the science lesson, as classes may need the proper word to discuss DDT, antibiotics, the A-bomb, the H-bomb. Since recent rulings require printed names of ingredients on the labels of breads, candies, many processed foods, as well as paints, drugs, textiles, and other commercial mixtures, these names should become part of the informed student's vocabulary.

There is a correct name for anything we wish to discuss with our students. Let their vocabularies —and ours—grow, and grow, and grow!

4. *The tools of education change.* Once the blue-backed speller, the prim geography, and the stern arithmetic seemed to be the only needs in school. Life itself was also drab at home and at work for nearly everyone. Today, outside the school, the youngster faces lavishly illustrated magazines, exciting movies, dramatic radio, vivid television. Whether for good or ill, for culture or frivolity, these media are teacher's media.

No wonder, then, that modern texts and readers for the grades are ablaze with color and vigorous in wording. They must compete with fascinating outside agencies of learning. Perhaps the grim, gray mistress of the old-time schoolroom should also be replaced by a bright, vivacious spirit who—whether 16 or 60—can indeed be a colorful teacher!

If one phrase may sum up an effective teacher's plan to fit into a developing curriculum, it would be the maxim, *Keep Up! Keep up* with new ways of doing things. *Keep up* with new devices on the market. *Keep up* with new words. *Keep up* with the news. *Keep up* with books for young folks' reading. *Keep up* with instructive programs on radio and TV.

Change your own curriculum a little every day. Devise new explanations, on the right level, for several new topics in the lessons of every week. Let each year's teaching leave you conscious of personal growth in worthwhile knowledge, which you will use in many future lessons.

One more thing. Science in any grade you offer it, is particularly rich in opportunities for teaching reverence for nature—its precision, its persistence. Even small children can be led to sense the marvel of life within a seed, or an egg, which anyone can see but no one can explain. This type of reverence for order and for truth can lead to holy thoughts—an appreciation of a Mighty Wisdom, an all-powerful Creator. This Wisdom and Power are unchanging!

Such concepts are not likely to be found in published curricula. We are not permitted to offer specific religious instruction in our public schools. There is no law, however, that prohibits an earnest teacher, at any level, to use instruction as an instrument to deepen the reverence of sincere students for truth, and to aid them—in their search for truth—to find God.

FIRST WEEK OF SCHOOL IN SCIENCE

A Symposium of Ideas and Experiences

(Continued from the April issue of *The Science Teacher;* concluded.)

Each fall with the beginning of a new school year, millions of eager youngsters thread their way into the science classrooms of our junior and senior high schools. For many of these pupils, this will be their first experience with a course in science, or with a laboratory course in science. How can we meet them more than half way and help assure that they—and we, their teachers—get off to the best start possible? The effective approaches of 13 contributors to the symposium were included in the April issue and we add 5 more here. If you find this to be a helpful exchange of ideas, won't you let us know!

Editor.

Biology again—this time as LORENZO LISONBEE gets his show on the road in Phoenix Camelback High School, Phoenix, Arizona. Much of the biology in his region is "desert biology," but it certainly isn't barren.

This teacher believes in "digging in and getting going" that first week. There are plants, animals, and other "props" in the classroom when the students come in that first day. But there are also some *empty* cages, aquaria, and terraria for student use, and it is surprising how quickly they are utilized. From the very beginning students are encouraged to go on their own, and they soon learn that to find answers to their own questions is one of the important features of the course.

A most valuable survey sheet is filled in, giving father's occupation, class schedule, past science experiences, hobbies, what they hope to be doing in ten years, and what they hope their life's work will be. Two or three "fun" quizzes may be given to help the teacher quickly determine who's who scholastically, and to build the attitudes that quizzes and tests are strictly devices for learning and self evaluation. The faster students are the first usually to be asked to assist the teacher and lead in group work. Later it may be found that others have greater leadership potentials.

Where do we start? It makes no difference where we start, providing the important concepts are hit during the year. It may be albino corn seedlings, insects—anything that will fire the enthusiasm of the students *and* the teacher and lead to important biological principles. To ask, "Shall we start by working with the microscope" has always aroused intense interest. During that first week we may learn how to use the microscope, prepare infusion cultures, and perhaps make our first examinations, with these questions in mind—What part have instruments played in the progress of science? What has the microscope contributed? How do scientists go about their work in solving problems and making discoveries? How can living things be so small and yet be alive?

During or near that first week, insect collecting may be discussed, with the thought that those who are interested (and most are) may get started while insects are plentiful. *Anticipation of exciting things ahead is an excellent teaching tool.*

From this first week, the course may evolve to the point where classroom organization permits a great deal of latitude for individual differences and interests through individual and group activities.

You've guessed it. It may soon become a "three-ring circus". But there's hardly a dull moment.

DEAN C. STROUD teaches ninth grade general science in the Amos Hiatt Junior High School in Des Moines, Iowa. Says he's teaching the second generation, now; still finds it fresh and exciting; looking for new ideas—and giving out a few in this contribution.

When a new semester of science work begins in my classroom, it really is a "get acquainted" session. I like to learn if any of the boys and girls have had brothers and sisters in my classes in previous semesters. Now I even find that these children are the children of former pupils! And so we have a good time exchanging greetings. This business of getting acquainted is done in a very informal way as program cards are being signed and class tickets are being written.

Another class period is given to the election of officers for the semester. Pupils are asked to volunteer their services and the members of the class elect the officers from this list of volunteers. Emphasis is placed upon regularity of attendance, definite attention to accurate record keeping, and the opportunity for service to the class and school. Usually at this session the specific equipment needs such as notebooks, folders, paper, and pencils are

explained and purchases made from the school supply room. This serves to start each member of the class with the necessary work materials.

Another class session is used to give an overview of the units of work to be done during the semester. Some of the units that relate to previous work in science are reviewed.

By now the members of the class have explored items that were new to them in the room. They have investigated the photographic darkroom in the corner of the room. They have had a peek into the cases that contain various items of experiment equipment. They have "gone through" the publications rack. They have discovered a maximum-minimum thermometer just outside the window and are curious about how a reading is determined and why the "little blue things" are in the tubes. And it seldom fails that someone doesn't want to know how a barometer in the room can foretell rain that will occur outside. All of these and more serve to interest the pupils in "what goes on in this room". When books are placed before the pupils by the book monitors it isn't a difficult job to get attention for the first unit of work for the new semester in science.

Do you like to use the history of science and the achievements of outstanding scientists in your teaching? This sort of thing makes an excellent first-week springboard according to W. PEMBERTON, head of the science department in Benjamin Bosse High School, Evansville, Indiana.

During the first week or two of school the teacher has an unique opportunity to drive home extensive concepts of a more intangible nature. The student has as yet few immediate school problems such as long and difficult daily assignments, term papers in English, extra-curricular duties, etc. He is able to concentrate more intensively and for longer periods of time. The scope of his mental vision is greater. The old saw to the effect that one is unable to "see the forest for the trees" does *not* apply. The experience of "school" is new and different again—all too briefly!

This is an excellent time to undertake an introduction to the history and philosophy of science. Later the pressing problems of the moment, the need to meet deadlines, the proximity of subject matter will make it difficult for the student to gain the appreciations so important in these fields. Frequently the treatment of these fields consists of unrelated discussions of biographies, experiments, and events, such discussions occurring when pertinent subject matter is being discussed. This method is probably desirable as a means of putting subject matter across; however, it is not sufficient to provide a well-rounded science education. That which is lacking is adequate attention to the continuity of knowledge and the unity of man's efforts in obtaining it.

Every individual, every contribution, and every event of great significance should be presented in one picture which can be viewed in its entirety at one and the same time. Like the television screen which must be viewed at a sufficiently great distance that the absence of fine detail is not disappointing, the presentation by the teacher at this stage in the science education of the student must be void of an attempt to bring into it too much detail. Outlines painted by simple statements and analogies will suffice at this time.

If done well, this should serve as a source of inspiration to awaken and to foster an interest in science throughout the course, and longer.

General guidance, general orientation, and emphasis on the laboratory are points stressed by M. M. HASSE as he begins work in physics in the Central High School, Aberdeen, South Dakota.

That first week *is* important—for both students *and* teacher. Here are a few starting procedures, not necessarily original with me, which I have found useful.

As in most schools, our registration is carried out in the previous spring with due guidance, but a followup in September during the first week before class enrollments are "frozen" is desirable. I have never told a student, "You *can't* take physics", but I have found students who could more profitably take a different subject, and have advised them accordingly.

In the general orientation, the students and teacher go through the textbook for one or two periods looking at the illustrations and discussing the unit and chapter headings. The teacher hands out a mimeographed sheet on which are given the standards of accomplishment expected by the teacher; the form of laboratory reports and their time limits; standards of neatness for written assignments; procedures for makeup work; a list of scientific periodicals in the library; and suggested hobby activities and projects. Toward the end of the first week the students prepare a two-page essay on either of two topics: "Why I want to take physics"; or, "Fifteen questions which I expect physics to help me answer."

The students do not come into a bleak and bare classroom. From a collection of charts, posters,

and pictures I display eight or ten of general interest. These are changed after three or four days. Pieces of equipment that "run" stimulate interest, and give the students a foretaste of what is coming. Before the students come into the room I have set up such apparatus as a radiometer, a seconds pendulum connected to a telegraph sounder, a gyroscopic top, a prism mounted in a beam of sunlight, or a shortwave radio tuned in to receive dots and dashes. There are many eager questions, and after answering a few it is necessary to say, "We'll go into that more thoroughly in a month or two", or "We'll study radio in the spring".

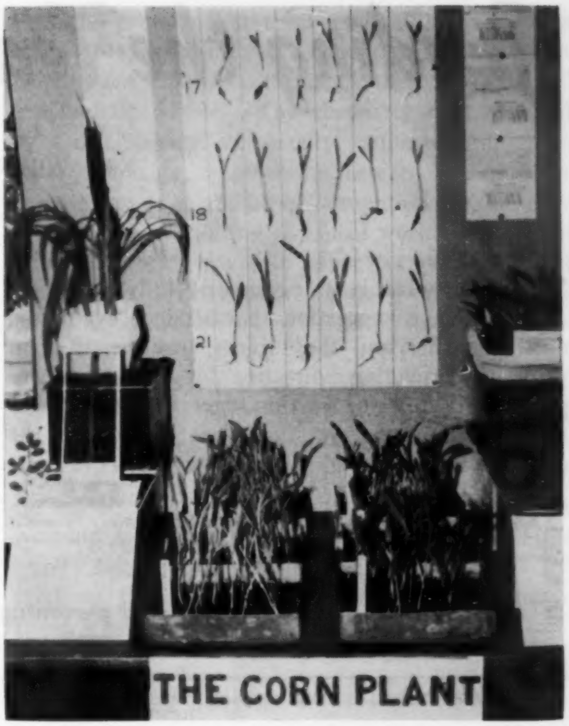
The remainder of the year is a challenge to me to maintain and enlarge the interests aroused during that first week.

Biology teacher, LOUISE A. SCHWABE of Kenmore, New York, Senior High School, says, "Bring 'em back alive!" Her contribution to this symposium tells you what she means by this.

Bringing the out-of-doors into the classroom through the construction of terraria and test-tube aquaria helps introduce our students to biology as a science of *living things*. To house and maintain both plant and animal life in a set-up comparable to their natural environment proves a fascinating experience, especially for those who have had limited opportunity to study nature in the field. I have used the following demonstration to start the school year with new students.

Collect plants such as small ferns, mosses, lichens, partridge berry and foam flower. If possible collect some rosemary, cranberry, leatherleaf, sphagnum moss, a pitcher plant, and several sundews. This will enable you to construct both a typical rich woodland scene and a bog. For fauna collect small frogs, toads, salamanders, and newts. Bring in sufficient humus soil and sphagnum moss in which to plant the specimens. Have the custodian salvage for you during the year pieces of glass from the repairs of broken windows. Cut these for the sides and cover of the terraria. Oil cans can be used as pans by cutting them in two and folding over the edges. Some adhesive tape, pebbles for drainage, a few larger rocks for woodland boulders, and glass dishes for ponds complete the list of materials.

Without much comment start to construct the scene. Allow students to gather around the demonstration table as you proceed. Questions arise immediately, especially when such specimens as the pitcher plant and sundews are available. Some students may recognize the plants you are using. Encourage them to tell all that they know about the specimen, as you continue planting.



Here is a portion of a project in which a student made good use of the type of terraria I have described. This project was entitled *The Spectrum and the Green Plant*. The student covered each terrarium with different colored cellophane. He then made a careful study of the growth of the corn plant under red, green, blue, and yellow cellophane covered cases, and he compared these with the results under clear colorless cellophane. One case was covered with black paper.

Now construct the glass case using adhesive tape to hold the sides together. Bind the top edge and the cover plate with adhesive also. Set the case over the planted pan. Just before putting on the cover add the small animals to complete the woodland scene. Many questions will arise at this point: Will the plants and animals live under the glass case? Why is the glass case necessary? What will the animals eat? Could I bring in some snakes and make a home for them?

If you have several beginning classes, you can plan to make several different terraria, a desert, an open field, a bog, and a deep rich woodland. In some classes you can make test-tube aquaria using small snails and seaweed which you have collected. Ask for volunteers to care for the terraria, and volunteers to plan any larger terraria or aquaria you may have in your room.

Using the various questions that have arisen during your demonstration, you are off for the year's work. From classification to conservation, the school terraria and aquaria will be constant sources of information, as well as constant centers of interest.

Grading the Teacher ✔ ✔ ✔ ✔ ✔

By WILLIAM BARISH

Frankford High School, Philadelphia, Pennsylvania

THE Pennsylvania state course of study in science[1] contains a suggestion that student evaluation of the teacher and the subject "can be of great value" in providing "direction for curriculum improvement". Acting on this suggestion, the author mimeographed the questionnaires printed in the course of study, changing it slightly to meet his particular situation. The questionnaire was given to his pupils who were completing their second semester of chemistry or the equivalent course in popular science. (In Frankford High School, popular science is the name given to the modified science courses which parallel the traditional science courses in biology, chemistry, and physics. Popular science is offered only to those non-academic pupils who would find the "regular" science courses too difficult.)

[1] Bulletin 400; "Course of Study in Science for Secondary Schools"; 1951; pp. 324-325; Department of Public Instruction, Harrisburg, Pennsylvania.

TABLE 1: A list of questions and percentages of pupils in both classes who responded "Yes", "Doubtful" (?), and "No".

QUESTION	CHEMISTRY			POPULAR SCIENCE		
	YES	?	NO	YES	?	NO
1. This science course was very interesting to me	88	8	4	91	9	0
2. I learned information that will be valuable to me after I leave school	77	15	8	66	25	9
3. This course will help me in my chosen occupation	42	23	35	11	31	57
4. The way this class was run helped me to make friends	81	15	4	80	20	0
5. Sometimes the subject was "over my head"	69	8	23	23	11	66
6. I would have learned more if I had been working somewhere	4	31	65	6	57	37
7. I had trouble in studying science	23	23	54	3	3	94
8. The teacher seemed to have some favorites in this class	15	15	69	3	3	94
9. My assignments in this class were clear and definite	100	0	0	97	3	0
10. My work in science taught me to think scientifically—to consider facts and make decisions	65	27	8	74	23	3
11. The only reason I worked in this course was to get a good mark	12	12	77	6	14	80
12. My teacher seemed up to date in what he knew and did	96	4	0	83	17	0
13. The teacher in this class did too much of the talking	0	8	92	11	9	80
14. I would like to have a science laboratory of my own	50	8	42	26	28	46
15. I would like to learn more about science	65	27	8	66	26	9
16. The teacher was too "standoffish" and hard to make friends with	4	4	92	0	0	100
17. I was afraid when I was called on	31	8	62	6	3	91
18. I had opportunities to express myself in this class	92	8	0	88	6	6
19. My teacher praised pupils more often than he blamed them	54	31	15	29	46	26
20. I felt free to talk over personal problems with the teacher	46	23	31	43	31	35
21. My teacher seemed to like his job	100	0	0	100	0	0
22. My teacher had a good sense of humor	100	0	0	80	17	3
23. Disciplinary cases were well handled in this class	88	8	4	71	26	3
24. Aside from the facts I have learned, this class was helpful to me (in teaching me to think, in changing my attitudes, etc.)	73	27	0	68	26	3

The questionnaire was given to the pupils on their last day of school for the semester. The boys and girls were assured that their marks had already been recorded, and that their answers would not influence their teacher's opinion of them. To reassure them, they were asked not to sign the papers, and the only identification was to mark whether they were chemistry or popular science pupils. Their teacher asked them to be frank rather than diplomatic. Table 1 shows the questions and the answers made by the twenty-six chemistry and thirty-five popular science pupils who took part. Note that in this table, the results are tabulated in the form of percentages.

TABLE 2: A Category of the Questions

CATEGORY	QUESTIONS
Value of the Course	2, 3, 6, 10, 24
Interest in the Course	1, 4, 11, 14, 15
Difficulty of the Course	5, 7, 9, 17
Opinion of the Teacher and of His Methods	8, 12, 13, 16, 18, 19, 20, 21, 22, 23

In order to evaluate the replies of the pupils, the questions were classified under four headings, as shown in Table 2. Each category was then considered separately. Since some of the questions had been phrased negatively and some positively, the answers were re-arranged to show favorable, doubtful, or unfavorable opinions.

Value of the Science Course

TABLE 3: Pupils' Opinions of the Value of Their Science Courses, Expressed in Percentages of Pupils.

QUESTION	CHEMISTRY			POP. SCIENCE		
	USEFUL	?	NOT USEFUL	USEFUL	?	NOT USEFUL
2	77	15	8	66	25	9
3	42	23	35	11	31	57
6	65	31	4	37	57	6
10	65	27	8	74	23	3
24	73	27	0	68	26	6

In only two places did the pupils indicate that their science course had little value. The replies to Question 3 show that the courses did not have as much occupational value as the teacher thought it would have. On the other hand, these low "marks" are understandable. The chemistry course would have occupational value only to those planning to enter medicine, engineering, etc. The popular science course might be of occupational value only to those contemplating technical work. Those pupils who were going into other occupations might not see any direct relationship between their course in science and their chosen field of work. In Question 6, one-third of the chemistry pupils and one-half of the popular science pupils expressed doubt. Of course, it is something that their replies were not outright negative ones, but it seems there is a problem of convincing pupils they are better off in school during their adolescence than they are working. From two-thirds to three-fourths of the pupils felt that the facts, the attitudes, and the methods they had learned would be of value to them after leaving school.

Interest in the Study of Science

TABLE 4: Pupils' Opinions of Their Interest in Studying Science, Expressed in Percentages of Pupils.

QUESTION	CHEMISTRY			POP. SCIENCE		
	INTERESTED	?	NOT INTERESTED	INTERESTED	?	NOT INTERESTED
1	88	8	4	91	9	0
4	81	15	4	80	20	0
11	77	12	12	80	14	6
14	50	8	42	26	28	46
15	65	27	8	66	26	9

The answers in Table 4 are more favorable toward the course than they were in Table 3. Except for Question 14, the boys and girls expressed a gratifying interest in science. It is quite understandable that many of them are interested in science and yet realize that it is not practical for them to have their own laboratory. It is noteworthy that the replies of the popular science pupils, on the whole, are slightly more favorable than those of the chemistry pupils. This may be because the course in popular science was purposefully designed to explain the chemical aspects of everyday life to these pupils whereas the chemistry course is

more the traditional type with greatest appeal to those pupils planning a scientific career. It is flattering to the teacher that less than about 10 percent of the pupils said they had no interest in learning more about science; however he recognizes the challenge of this 10 percent.

Difficulty of Studying Science

TABLE 5: Pupils' Opinions of the Difficulty of Their Science Courses, Expressed in Percentages of Pupils.

QUESTION	CHEMISTRY			POP. SCIENCE		
	TOO DIFFICULT	?	NOT TOO DIFFICULT	TOO DIFFICULT	?	NOT TOO DIFFICULT
5	69	8	23	23	11	66
7	23	23	54	3	3	94
9	0	0	100	0	3	97
17	31	8	62	6	3	91

Despite the fact that the pupils admitted that their assignments were clear and definite (Question 9), 69 percent of the chemistry pupils felt the subject was "over their heads" at times (Question 5), almost one fourth admit they have trouble in studying the subject (Question 7), and almost one third expressed fear when they were called on in class (Question 17). The fact that some of the pupils had to study hard is not worrisome to the teacher, but it is of concern to him that many pupils dread being called on. He has attempted to maintain a friendly atmosphere in his class, and it was startling to him to learn that some pupils were afraid when he called on them. He is puzzled over the solution to this problem.

As was to be expected, the majority of the popular science pupils had no difficulty with their subject. This, of course, was by design. The course does contain a little bit of theoretical chemistry, and this may account for the fact that 23 percent said they were sometimes "out beyond their depth" (Question 5). The theoretical aspects cannot and should not be eliminated altogether, so long as they are made reasonably simple for these pupils.

Table 6 shows the teacher failed in two places. Question 19 shows that the teacher has fallen into a fault all too common among adults dealing with young people. We tend to expect good things from our pupils without praise; yet we are too quick to criticize when they do not come up to our expectations. It is a fault that needs correcting.

Although Question 20 also gives the teacher a failing mark, he does not feel too bad on this point. Considering the reticence most adolescents have towards most adults, he is gratified the answers were as favorable as they were.

In addition to the questions to be checked, the pupils were invited to write any suggestions they had for improving the course. Unfortunately, most of the pupils did not avail themselves of this opportunity. A few wrote favorable comments. Some of the unfavorable criticisms were beyond the control of the teacher, such as problems in rostering. Two pupils expressed a desire for more laboratory work. Two popular science pupils made contradictory requests, one wanting more topics covered less thoroughly and another asking for the exact opposite. Some popular science pupils expressed dissatisfaction with the marking. The teacher had made this course easy to pass but difficult to get high grades in, and the pupils wanted the same treatment in marks that chemistry pupils received.

Although the study contained too few cases to be scientifically acceptable, it is presented as an informal study, which may be of profit to other teachers to undertake. Even if a teacher is "passed" by his pupils, he may find a few places where he needs improving.

Evaluation of the Teacher and His Teaching

TABLE 6: Pupils' Evaluations of Their Teacher and His Teaching, Expressed in Percentages of Pupils.

QUESTION	CHEMISTRY			POP. SCIENCE		
	LIKE	?	DISLIKE	LIKE	?	DISLIKE
8	69	15	15	94	3	3
12	96	4	0	83	17	0
13	92	8	0	80	9	11
16	92	4	4	100	0	0
18	92	8	0	88	6	6
19	54	31	15	29	46	26
20	46	23	31	43	31	25
21	100	0	0	100	0	0
22	100	0	0	80	17	3
23	88	8	4	71	26	3

THE APPRAISAL OF NATURAL RESOURCES

By PAUL B. SEARS

Professor of Conservation, Yale University, New Haven, Connecticut

ANYONE WHO CAN READ labels, count, and tally can make an inventory. To make an *appraisal,* however, one must understand values as well. And when it comes to natural resources, even the inventory is a tough job. Our continent is big and complicated. We know how big it is in square miles, but we are a long way from knowing what is in it, and what those things are good for. Our forest resources, for example, cannot be measured by the square miles of trees, but by their size, number, and quality. Water cannot be measured in inches of rainfall alone. Evaporation, which is seldom measured, is no less important. Twenty inches of rain is enough to produce forest in Canada, but supports only desert in Mexico. Soil is not just the mantle of loose rock on the surface. There are many types, each with its special values and limitations. For example, the kind of soil most efficient in yielding high protein food-stuffs is limited on every continent to those prairie lands which have come to be known as the world's bread-baskets. Incidentally, we are about as well supplied in this respect as any nation, including gigantic Russia, but that is no excuse for waste.

The minerals of our continent mostly lie underground and concealed. We have searched hard for them, but I am told by engineers that we have tapped only a few cubic miles, while our planet contains something like 268,000,000,000 cubic miles. Not too many years ago, when I was a guest of the Royal Canadian Institute, I was regretfully informed that Canada would have to depend upon us for iron ore through time to come. I was told this by a good geologist who had just finished a long prospecting trip up to the Arctic Circle without results. Today we know of vast deposits in New Foundland, and others in South America. This again is no excuse to be wasteful. As our own supplies are being used up, the cost of transportation must be added, while the richest mines have their limits.

Thus you see that even the simple business of finding how much is not simple when we come to natural resources. It is further complicated by two other, and very human, factors—*Anxiety* on the one hand, *Wishful Thinking* on the other. For years I have been interested to see how biologists have differed from professional stockmen in their estimates of the number of cattle that can be safely grazed on certain types of grassland. In the same way, geologists have differed from engineers and business-men on the same problem. Let me emphasize that this can and does happen when all concerned are quite honest about the matter. People do not differ only when their paychecks or friends are involved. They often differ after they have seen the same thing and try in perfect good faith to tell about it, as every lawyer knows.

Another complication lies in the fact that if we go much beyond air and water, which any animal must have to stay alive, resources take on their status largely in terms of the social system or culture pattern which depends upon them. This is true even of one man's food, which can be the other man's garbage, if not his poison. The flint mines which were so important to the Indian mean no more to us than our aluminum mines meant to him. The demand for newsprint is doing to modern forests what the need for charcoal in steel-making did to the forests of medieval Europe.

Even the theories of economists and the politicians who put them into practice are important. Denmark and Sweden realized a long time ago that their boundaries would not stretch. In consequence we see little waste there. A Swedish paper mill that has operated for more than a century by wise management of its own forest has every prospect of staying in business permanently, using the same source of raw materials. On the other hand, we have our believers in an expanding economy. Unless they qualify their belief, we must assume that they mean what some astronomers mean by an expanding universe—one that has no conceivable limits. This is a large order, even for such a great continent as ours, for it certainly has its limits of space, material, and reserve energy.

In this instance, the optimists offer us something more than inventory. What they offer us is rather an appraisal. And the thing they are appraising as without limit is human ingenuity. They see it as equal to any emergency, however great. Anyone knowing the miracles that science has accom-

This paper was given as a major address at a general session of the NSTA Second National Convention, April 2, 1954, Chicago, Illinois.

plished to date may be a bit timid about questioning them. I do recall, however, Lesson One in an old-fashioned book of physics, entitled, "Two Bodies Cannot Occupy the Same Space at the Same Time." So far as I know, it still stands and it continues to trouble me. Granting what is theoretically possible, that the earth can be made to produce food enough for 25 billion people, it is still a comforting thing not to have to stand up when one is eating. Space is after all a basic natural resource, as anyone who has planned a garden or even a living room should know.

It is proverbially the youngest baby in the family who raises the most Hell, and man is nature's youngest. Mother Earth is between 2,000 and 3,000 million years old; Man less than 1 million. The Old Lady was already well set in her ways when he appeared. Repeatedly he has wrecked his home, repeatedly he has been spanked, but stubbornly he persists in having his own way which he calls "The Conquest of Nature." It is my own suspicion that it is time for him to learn the House Rules.

There was set up for him a magnificent system of operation on the landscape, consisting of living communities and the soil which sustained them. This system received and used the impinging energy of the sun, the minerals of the earth, water, and the substance of the air in order to sustain itself and all life. The energy was constantly renewed, but the material stuff was used and reused in orderly cycles—a kind of natural conservation at its best. Water was retarded on its return to the sea whence it came, minerals and organic material were restored to the earth to enrich it. The system had its defects, no doubt, but within its limitations it had an efficiency and permanence which combined would serve us well as a model for our own operations on the land.

As to ourselves, we render waterproof our thirsty cities, and make even our farms less permeable than the forests and prairies which they have replaced. Our sewage and garbage, with rare exceptions, is transported away from the land which produced it and rendered unavailable, carrying off and depleting the organic material and minerals so much needed to keep that land fertile. Certainly any fair appraisal of natural resources must reckon, not only with the supplies present on our continent, but with the changes we have produced in the great natural cycles which have so long conserved those resources.

The question, of course, is "What can be done?" Personally, I think much can be done, but the problem is so big that it must be taken in small

portions at a time, just as we do with any big and complex problem. These portions are the local communities in which each of us lives, where we have a chance to see at first hand what is happening, and a chance as free men and women to do something about it. This is not only good technical conservation, but good political doctrine, too, for as Lincoln suggested, a duty dodged is a privilege lost.

It is precisely at this point that teachers enter the picture. The remarkable success of Britain, when beleagured during the last war, in producing foodstuffs at home was based, in no small part, upon the excellent land-use study mapped 7 inches to the mile by school children under the direction of Dr. Stamp. There is not a community in our land that does not abound in excellent teaching materials which can, at the same time, be put to good use in the long-time service of the community. It requires guidance from those trained to see, not only what is present, but *what is happening*.

How do we learn to see and interpret? Most of us probably know that, for all the power that words possess, they alone cannot teach science. One must experience, with all the senses possible, the phenomena themselves to grasp their meaning and relationships. In short, one must live with his materials. Then, if he is sufficiently clever, he can begin to use words and other symbols to tell others.

I know no better way to learn the art of reading the landscape and the science of interpreting it than to see it under the guidance of masters. I am no friend of the summer school which obliges its victims to walk on concrete and hurry by corridor and elevator from one honey-comb classroom to another. At best it is a necessary evil for our profession—at worst an intolerable affront. Even those of us who must use laboratory and library ought to have a chance to do so where there is fresh air and greenness, and those of us who study the world of living nature and its landscapes *must* do so.

One of the most heartening and impressive experiences I have had in recent years was a visit last summer to the Audubon Nature Camp, Damariscotta, on an island off the coast of Maine. It was a summer laboratory to which the buildings were merely a necessary adjunct. The laboratory itself was the forest, the rocks, the beach, and the sea. The instructors were master naturalists, glad to learn and glad to teach, proud to share their craftsmanship and knowledge with anyone, and not burdened with the idea that the only road to glory lies in training future Doctors of Philosophy.

Living conditions were pleasant, the atmosphere at once brisk and relaxed, serving as a reminder that vigorous and interesting exercise out of doors brings a happier relaxation than the psychoanalyst's couch—a lesson we can use.

Two things especially impressed me—the generous and skillful teamplay of the staff and the final wholeness of the picture of a region—not only of its animal and plant life, but of its structure and the processes which made it a living unit. Finally, the shortness of the session seemed to help, for it left each visitor (or student) with clear and fresh impressions of what he had learned.

I mention this camp because here I had finally seen the kind of establishment I had long urged for teachers. Please do not gather that I am discounting the stern, systematic scholarly discipline which the specialist must have. I know and respect it. But, just as music would be in a sorry way if it were denied to all except those who enrolled in a conservatory, so with the love and understanding of nature. And I trust I have made clear that such understanding, widespread among our people is, in my judgment, vital to the survival of those values by which we live.

I have suggested one pathway. There are many others, leading to the same end, which is an understanding of the immediate world around us and of our responsibility toward it. The village druggist in an Indiana town used to take walks on Sunday afternoons with his friend the banker, who was a naturalist. Soon he became interested, and presently he became proficient. To him that state owes a great deal for its beautiful state forests, some of the first and finest of their kind. He, as an amateur, even went farther and published a state flora which commands the respect of professionals. One need not stand by helpless because he has not had formal courses in something which interests him.

Everyone admits that the teacher, particularly at the secondary level and below, is a hardworked citizen. Everyone admits that he is an important citizen, although the tangible rewards are not often in proportion. I have tried to show you that he must have a great deal to do with the way in which America handles her natural resources. Nearly every student in our Yale Conservation Program had his first inspiration, if not at home, then from a teacher whom he remembers with gratitude. If the challenge seems a bit heavy, let us remember what someone said—"There is no limit to the good a man can do if he doesn't care who gets the credit."

Classroom Ideas

Elementary Science

Lightning at Your Finger Tip

By HARRY MILGROM, Supervisor of Science,
Elementary Division, New York City
Board of Education, Brooklyn

Ben Franklin, in his famous kite experiment, showed that lightning was an electric spark. You can be a Franklin too, by making a miniature lightning and thunder device, with just these four parts:

1. A plastic food bag or other similar plastic material.
2. A nine inch pie plate.
3. A plastic drinking straw.
4. A small rubber "suction" cup of the type used on children's arrows.

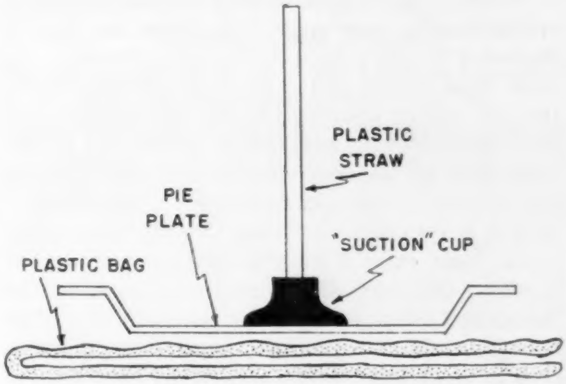
To assemble:

1. Moisten the "suction" cup and attach it to the inside center of the pie plate.
2. Insert the plastic straw in the "suction" cup hole to form a handle.

To use:

1. Fold the plastic bag so that it fits under the pie plate.
2. Rub the bag briskly, several times, with the back of your hand, to give it an electric charge. (If the plastic is well charged, it will, when brought near an exposed arm, lift the hair and produce the sensation of a wind blowing over the skin. Try a different plastic, if yours fails to pass this test.)
3. Place the plate on the charged bag and touch the plate with your finger.
4. Lift the plate by the plastic straw handle. It is now highly (but harmlessly) charged with negative electricity.
5. Slowly approach the rim of the plate with a pointed finger.

If all is well, a spark (the LIGHTNING) will jump between the finger and the rim, when they are separated by about one half inch. A crackling sound (the THUNDER) will accompany the spark. Darken the room to make the spark more spectacular.



Steps 3, 4 and 5 can be repeated many times without recharging the plastic bag.

This is a home-made version of the electrophorus, which was invented by Alessandro Volta towards the end of the 18th century. It is the great-great-grandaddy of modern atom smashing machinery.

For the theory of operation of this device, consult a high school physics text.

Physics

It's Easy to Teach the Six Cases of the Convex Lens

By NELSON P. PALMER, Teacher of Physics,
Butler Senior High School, Butler, Pennsylvania

Many physics students never understand the six cases of the convex lens and their correlation. They know that a convex lens "magnifies things" and many may have burned a hole in a piece of paper while passing sunlight through a lens. In physics they soon learn that convex lenses can be used to form images and that sometimes the image is inverted and a different size than the object. They learn many facts but they often fail to see how one fact leads to another. You, as teacher, can present refraction by a convex lens in an interesting manner. And at the same time you can help your students organize their learning and correlate facts.

No student can understand the use of a convex

lens until he knows a few basic definitions and the general cause of refraction. He must know that the term ***normal*** is synonymous with perpendicular. It is well to stress the definition of the ***angle of incidence*** until he never fails to recognize that one side of this angle is always the normal. And when it comes to the ***angle of refraction*** he must know that it always lies wholly in one medium.

"When a ray of light enters a medium of greater optical density at an angle of incidence less than 90 degrees it is bent toward the normal." Students can learn these words and make diagrams illustrating this law without knowing why this statement is true. Consider a moving automobile: If the right front wheel goes off the concrete onto the soft berm, the car is forced to the right because the right side of the car is retarded more than the left side. Let a ray of light enter a piece of glass at an angle of incidence less than 90 degrees and it bends toward the normal. The light travels slower in glass than it does in air. Since the ray entered the piece of glass at an oblique angle it was forced from its path much like the moving car.[1]

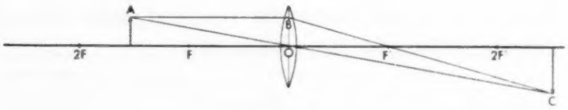


FIGURE 1

Figure 1 represents some of the terms a student must learn before he studies the six cases of the convex lens. Not all the terms are defined here; you can use the definitions found in any physics text. F and F′ are the two principal focuses; the line joining these points is the principal axis. AOC is a secondary axis which always passes through the optical center of the lens.

Put an object in front of a convex lens. Rays of light bound off in all directions from point A in the object. Some of these rays pass through the lens. The ray OAC, travelling along a secondary axis, passes through the lens without refraction. AB is another ray from point A that goes through the lens. It is parallel to the principal axis and refracts through the principal focus at F′. (We are not considering spherical aberration.) The ray strikes the lens obliquely and is turned from its path like the automobile previously mentioned. These two rays from point A meet at C and form an image of the point. Therefore, to locate the image of a point formed by a convex lens, choose two rays of light from the point: one ray travelling along a secondary axis and one ray parallel to the principal axis. We know how these rays go through the lens and we can diagram their path. Where these two rays cross we find the image of the point. In a like manner we could locate the image of every other point in the object.

Many physics texts show six diagrams of the convex lens with the object at places all the way from infinity to a point between F and the lens. These diagrams are good but they often leave the student with six disconnected ideas that he may never master and much less ever hope to correlate. Let your students make such diagrams for three of the easiest cases, viz., case 2, case 4 and case 6. The following table establishes the numbering of the cases:

Case	*Location of Object*
1	Infinite distance beyond 2F
2	Finite distance beyond 2F
3	On 2F
4	Between 2F and F
5	On F
6	Between F and the lens

If the students diagram case 1, case 5, and case 6, they probably will find some difficulties. In case 1, for example, the object is so far away the rays from it are parallel and you cannot locate a secondary axis. In case 5, the rays leave the lens parallel to each other and since parallel rays never cross, no image is formed. You may think of this as the reverse of case 1 and say the image forms at an infinite distance from the lens and is so far away (and so large) that it cannot be seen. In case 6 the image is virtual and forms on the same side of the lens as the object is located. The rays must be extended "backward" to cross and thus to locate the image.

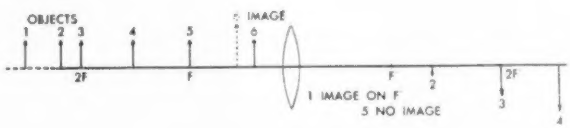


FIGURE 2

Constructing each of the six cases is desirable, but the relationship of these cases is best shown by making a composite diagram. Figure 2 shows the six cases as you might construct them individually and then erase the construction lines. The left side of the diagram shows the six positions of the object

[1] Without being critical of the author—because the use of analogies is common in science teaching—one might inquire just *how* or by what logic the student can or should be expected to relate the off-the-road automobile and a ray of light impinging on a lens and come up with a crystal clear "understanding" of refraction. Teaching ideas and concepts is not easy. *Editor.*

and the image for case six. The right side of the diagram tells the story about the other images.

In case 1, the dotted portion of the principal axis indicates the object is "infinite distance beyond 2F." At infinite distance all the rays from the object are parallel to the principal axis; they all meet at F′. Hence the image is a point and cannot be diagrammed. If you consider the objects as being all of one size in different positions, you can easily compare the size of the image with the size of the object.

Now suppose the object is brought from infinity to a point close to the lens; the image goes away and gets larger. When the image becomes infinitely large (case 5) is disappears. Then a magnified virtual image appears, illustrating case 6.

It is absolutely necessary that the objects and the images be represented by arrows. This distinguishes real images from virtual images. Since real images are always inverted, the arrow points in the opposite direction from the one representing the object. With this diagram it is easy to see that case 5 is a reversal of case 1, and case four is a reversal of case 2. When your students have mastered this diagram they can easily fill in a table similar to the following. Then they will know the six cases of the convex lens and how they are related.

Case	*Location Object*	*Location Image*	*Kind*	*Relative Size*
1	Infinite dist. beyond 2F.	F′	Real	Point
2	Finite dist. beyond 2F	Between F′ and 2F′	Real	Smaller
3	On 2F	On 2F′	Real	Same size
4	Between 2F and F	Beyond 2F′	Real	Larger
5	On F	No image because rays are parallel		
6	Between F and lens	Behind object	Virtual	Larger

Recalling any case of the convex lens now resolves itself into the ability to bring to the mind's eye the composite diagram, choose the case wanted and describe it. Students should remember there is only one thing to tell about the object and three things to tell about the image.

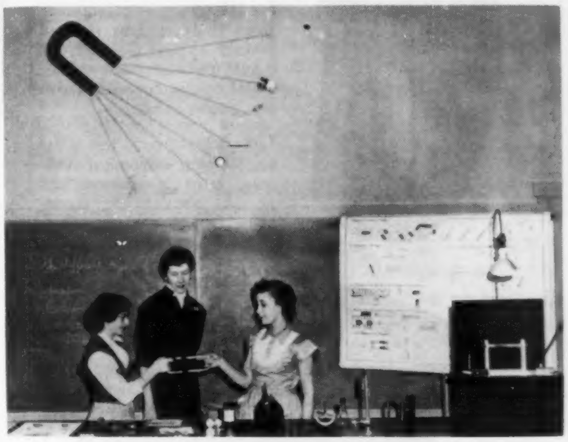
Some students may ask, "Why learn all this?" Then you can illustrate each case by the applications found in optical instruments. Case 1 is illustrated by the objective lens in the astronomical telescope; case 2 and case 3 are illustrated in the terrestrial telescope and the camera. Case 4 is used in the motion picture projector. Case 5 is often used in searchlights where no image is wanted. And case 6 gives simple magnification of a postage stamp and it may be found in the eyepieces of many telescopes and microscopes. Class discussion reveals many other examples.

If you like teaching the six cases of the convex lens by using this composite diagram, you may want to try the same method with the six cases of the concave mirror.

Teacher Education

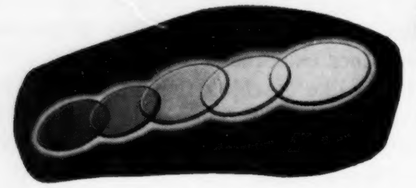
Here's One Way

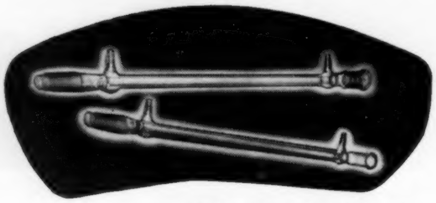
By JOHN M. ROTH, Department of Science Education, State Teachers College, Millersville, Pa.



This picture may suggest one way to introduce physical science to the primary grades. The young lady, Shirley Ann Walters, a senior doing her student teaching in the Campus Junior High School of the Millersville State Teachers College, is showing two of her ninth grade science students some principles of magnetism which they in turn will pass on to the kindergarten pupils of Miss Betty Ruth Jennings. The two girls who are interested in becoming teachers will be able to find out by actual participation if they will like teaching as a profession, and the kindergarten pupils will enjoy variety in their learning experience. This might be called "Learning by Doing", "The Chinese Method", "A Laboratory Teaching Experience", or a "Quadruple Play—science supervisor, to student teacher, to ninth grade science class, to kindergarten pupils."

By this method, as well as by two others—(1) Inviting the primary classes to visit the junior or senior high school science laboratories either while classes are in session or during an open period, or (2) Giving advice, encouragement, and information so that upper grade subject matter specialists can help teachers of the elementary school with a non-science background overcome their feeling of inadequacy and get off to a flying start in the rewarding field of science education.





NSTA Activities

NSTA Regional Conference

Lake Texoma, Oklahoma, October 14-17

It's time for all science teachers to make their plans to attend the 1954 fall regional conference to be held at the University of Oklahoma's Biological Station in southern Oklahoma, October 14-17. An unusually varied terrain will appeal especially to the nature and conservation enthusiasts and the laboratories will offer opportunities for the experimentalists.

Program

The program is being planned around the theme, "Enriching the Science Program." It will include sessions for all grade levels from 1 through 12 and for all fields of interest, general science, biological science, and physical science. Those attending will find a lot of inspiration in the star gazing, bird walk, and field trip sessions to take back to their classrooms. The advisory planning committee is going to make sure that no opportunity to enrich the program of the conference is overlooked. Plans also include a small exhibit of textbooks, scientific apparatus, and other science teaching aids. In view of the fact that a printed program will be mailed to all members in Oklahoma and seven neighboring states, only the highlights are outlined here in the Program Box.

Arrangements

The Biological Station is located approximately 140 miles south and east of Norman, the site of the main campus of the University. The Station will be opened for this off-season occasion. NSTA-ers will have the whole countryside to themselves. *In order to take advantage of the many opportunities and to facilitate*

Program

Thursday Afternoon and Evening, October 14

REGISTRATION: 3:00 p.m., Main Building, Biological Station

EVENING PROGRAM: 7:30 p.m.
- Address of Welcome
- Presidential Address, Walter S. Lapp, President NSTA
- STAR GAZERS

Friday Morning, October 15

KEYNOTE SPEAKERS

DISCUSSION GROUPS (concurrent):
1. Student Projects as Part of the Curriculum
2. Recruitment, Training and Certification of Science Teachers
3. Techniques in Elementary Science
4. Providing Field Laboratory Experiences
5. Science Fairs and Junior Academy Activities

Friday Afternoon, October 15

DISCUSSION GROUPS, continued
FIELD TRIPS
RECREATIONAL ACTIVITIES

Friday Evening, October 15

BANQUET WITH FEATURED SPEAKER
STAR GAZERS

Saturday Morning, October 16

BIRD WALK
GENERAL SESSION: Business-Industry-Education Keynotes
DISCUSSION GROUPS, continued
FIELD TRIPS

Saturday Afternoon, October 16

GENERAL SESSION: Technique Demonstrations for Preparation and Preservation of Biological Specimens
- Effective Use of Equipment in Physical Science

DISCUSSION GROUPS: Presentation of Reports
MEETING OF OFFICERS OF STATE GROUPS
(Scheduled Session ends but Station will remain open through Sunday noon)

Saturday Evening, October 16

MEETING OF OKLAHOMA MEMBERS

Sunday Morning, October 17

SURVIVORS' CHOICE: Bird Walks, Field Trips, Laboratory Demonstrations or Recreational Activities.

Recreational activities include fishing, boating, hiking, swimming, and conversation. If you plan to fish, bring along either a Texas or an Oklahoma license. If you want to boat, the craft are there but without motors.

Regional Meeting Details

Meals

First serving—Supper, Thursday, October 14
Last serving—Luncheon, Sunday, October 17
All meals cafeteria style

Lodging

Double deck bunks; linens furnished
Men—Dormitory
Women—Two-room suites with private baths; number of occupants per suite determined by total registration

Costs

Bed and board—$5.00 per day; separate meals charged according to scale
Registration—$3.00; please use form in program announcement being mailed separately

Clothes

Rough and ready; something warm

Access

Map of highways on printed program
Inquire of H. H. Bliss for rail connections

Further Information

H. H. Bliss, University of Oklahoma, Norman, Oklahoma

Emergency Address at Station (During Conference period only)

Telephone through Kingston, Okla., 816-F-13

arrangements, advance registrations are requested. Please use the registration form which you will find in the program announcement being mailed separately. Your registration fee of $3.00 should accompany your registration; pre-dated checks to October 7 will be honored. Tickets for meals and lodging for actual time registered may be purchased at time of arrival. If further information is desired, address inquiry to Horace H. Bliss, University of Oklahoma, Norman.

The Station may be reached only by automobile. A map showing routings through Durant, Madill, or Marietta will be available on request. In case of train travellers, arrangements for meeting all through trains at Durant (Katy, Frisco) or Marietta (Santa Fe) will be made when requested in advance.

Committee

Co-chairmen for the conference are Wayne Taylor, Denton High School, Denton, Texas in charge of the program and Horace Bliss, University of Oklahoma, Norman in charge of arrangements. They are being assisted by an advisory planning committee from eight states. Members of this committee are Ruth Armstrong, Fort Smith Junior Highschool, Fort Smith, Arkansas; Don Q. Millikin, Kansas State Teachers College, Pittsburg, Kansas; Leonard Kilgore, Louisiana State University, Baton Rouge, Louisiana; Otis W. Allen, Greenwood Highschool, Greenwood, Mississippi; Bolton C. Price, Jackson College, Jackson, Mississippi; F. Olin Capps, Jefferson City, Missouri; Lowell Shumaker, Roswell, New Mexico; Marian H. Nelson, Midwest City Junior Highschool, Midwest City, Oklahoma; Greta Oppe, Ball Highschool, Galveston, Texas.

We hope you'll agree this promises to be a meeting in keeping with the fine tradition of NSTA Regional Conferences and one that all science teachers will want to be a part of. Won't you start making plans now so that you and your colleagues will be on the roster of advance registrants? If you should need any assistance in obtaining released time from teaching responsibilities, contact either of the co-chairmen or the NSTA headquarters office. Let us know what your need is and an appropriate letter will be sent to your principal, superintendent, or any other person you may name.

NSTA Meetings—Past and Future

During the past year, meetings of NSTA have been held at the University of Colorado, Boston, Chicago, and Columbia University in New York City. One year from now, additional meetings will have been held at the University of Oklahoma Biological Station at Lake Texoma (Oct. 14-17; see below); Berkeley, California (Dec. 27-30, in conjunction with the annual meeting of AAAS and in cooperation with NARST); Cincinnati, Ohio (National Convention, March 24-26); and the University of Wisconsin (June 27-29, in conjunction with the annual meeting of NEA which will be held in Chicago, July 3-8).

Many of the addresses delivered at NSTA meetings, as well as classroom "Here's How I Do Its" and other appropriate items, are channeled to all members by way of *The Science Teacher*. When time and money permit, summary "Proceedings" of various meetings are compiled and made available free or at low cost. All of this is in line with basic Association policy of keeping close to "grass root problems" and making the results of such efforts available to all science teachers everywhere.

The Chicago convention was a grand success with nearly 900 registrants and a probable total attendance of 1200. Breakdown of registration showed the following numbers and major fields of interest: 236, elementary science; 227, physical science; 200, biological science; 195, college level; 189, general science. The tours were taken by 245 and 299 persons attended the banquet. The luncheon sponsored by Illinois science teachers attracted 236. Educational and commercial exhibits (25 of the former, 40 of the latter) were easily one of the best-liked features of the convention.

The 1954 annual summer conference held at Columbia University was attended by 150. Inspiring and informational talks, six discussion groups, a panel discussion, and a dinner session comprised the program. The dinner address by Dr. George S. Counts stimulated grim determination among those who heard his account of science teaching in the Iron Curtain countries today and the implications for American educators.

Actions Taken by the NSTA Board of Directors

The 1954 annual meeting of the Board of Directors was held June 26-27 at Teachers College, Columbia University, in New York City. Important actions taken by the Board may be summarized as follows:

1. NSTA to "spearhead" a national conference on the recruitment, training, and certification of teachers for high school science.
2. NSTA to urge appointment of needed science education specialists in U. S. Office of Education.
3. NSTA to expand and strengthen services to teachers in elementary school science.
4. NSTA to cooperate in NEA's Centennial Action Program. (The CAP will come to a climax in 1957 at the annual summer meeting in Philadelphia.)
5. NSTA to review and strengthen its program of relations with industry (via the Advisory Council, the B-I Section, and FSAF).
6. Authorized several new NSTA committees: research in science teaching, general science, biological sciences, physical sciences, and extra-curricular activities in science.
7. Reaffirmed approval and encouragement of activities now carried on through NSTA's Future Scientists of America. Expressed appreciation for continued support of American Society for Metals for the student and teacher awards programs and of the Crown Zellerbach Foundation for this summer's West Coast Conference held at Oregon State College.
8. Approved general budget of $88,125 (of which only $33,500 is anticipated income from memberships and subscriptions) and probable budget of $40,000 for the Future Scientists of America.

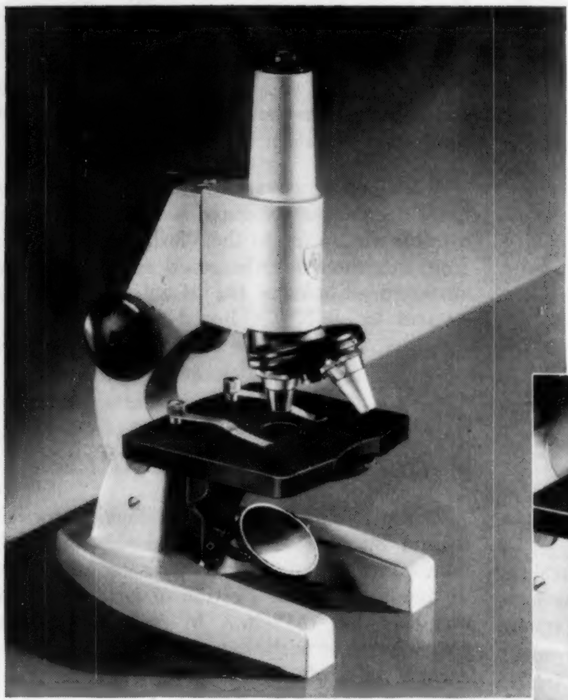
A few copies of various committee reports and other basic documents presented at the Board of Directors meeting are on file in the Washington office. Inquiries from interested members and affiliated groups will be answered. Copies of the Minutes of the Meeting will be sent to all NSTA Board members, state and area directors, and executive heads of affiliated groups.

Zachariah Subarsky, *Secretary 1953-54*

Suggestions Invited

By Committee on Nominations

Chairman Gladys Benner is looking forward to the helpful suggestions of the membership so that the nominating committee may present an attractive slate of nominees for the election of new officers and Board members for 1955-56. In making recommendations please include with each name, position and a brief account of professional interests and activities. Send all recommendations to Dr. Gladys Benner, Special Consultant in Science, Board of Education, Philadelphia, by December 1.



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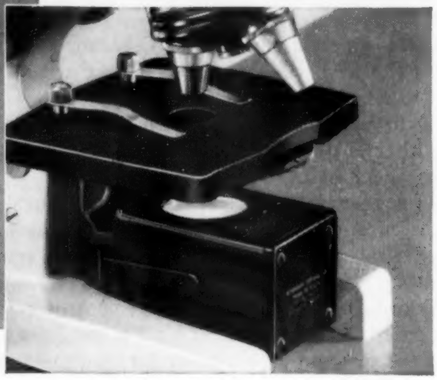

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Single Adjustment

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Price

No. 73S Microscope, with 10X and 43X objectives, 10X eyepiece, just **$109.00** ea.
In lots of five or more, only **98.10** ea.

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FSA Activities

▶ 1954 Winners

Science Achievement Awards for Students

Can a rusted object be cleaned by using it as the cathode in a sodium chloride electrolytic bath? Will aspirin tablets really keep cut flowers fresh? Will the methods used in dyeing aluminum also work on stainless steel? Can a sugary cattle feed be made from sawdust? Will injecting plants with fertilizers help the plants grow? Does the shape of a bullet affect its velocity? Does the presence of certain trace elements in the soil affect the shades of red found in autumn dogwood leaves? Does the kind of plating on a TV antenna affect reception? Is there correlation between the width of annual tree rings and the amount of rainfall or sunlight? Could the pitting of windshields in Spokane be due to meteoritic particles? How does mild punishment affect the rate of learning of albino rats?

The reports of projects entered in the Awards program leave little doubt that our science teachers are keeping alive America's vigorous spirit of scientific inquiry and investigation. Students leave few stones unturned in their quest for topics to study or problems to solve. It is true that the ambitions reflected by some of the titles would cow a sophisticated scientist; nevertheless, many projects successfully shed at least a ray of light on significant problems. When one reads about the boy who filled a model automatic transmission "with sugar because the usual oil was always leaking out," his faith in Yankee ingenuity is completely reaffirmed.

The NSTA, the Foundation, and the American Society for Metals extend their sincere thanks and congratulations to the hundreds of students and teachers who have been responsible for the entries in the 1954 Awards program. They add up to a truly outstanding achievement.

Widespread announcement of the program in the nation's 27,000 high schools called attention to the urgent need for science-trained people in our society. The eight regional judging committees and the national judging committee are to be commended for the careful evaluation of each of the 953 entries.

It is unfortunate that we cannot report the judges' discussion of the many interesting and thought-provoking projects. Space permits us to list only award winners. The 378 students receiving honorable mention and their teachers have been notified by letter. It is interesting to note the number of projects among those receiving honorable mention recognition that were sponsored by the same teacher. Notable among them are:

Mrs. Vivla Johnson, Norman Jr. H. S., Norman, Okla (24).
Sister Marie Martinien, S.S.A., Notre Dame H. S., Central Falls, R. I. (13).
Sister Ernestine Marie, S.C.H., Ryan Memorial H. S., Dorchester, Mass. (9).
Louise Schwabe, Joseph Clements, Berne Clarke and **Rolland Gladieux,** Kenmore Sr. H. S., Kenmore, N. Y. (10).
Mrs. Madeline Mahoney and **Genevieve Lamp,** Canastota Central School, Canastota, N. Y. (9).
Louise Hollweg, Steve Hall and **Alfred Lazow,** Haven Intermediate School, Evanston, Ill. (10).

CHECK YOUR NSTA PACKET FOR THE ANNOUNCEMENT OF THE

1. **1955 Program of Science Achievement Awards for Students and Recognition Awards for Science Teachers.**
2. **1955 FSA Student Chart Making Contest.**

Complete information may be obtained from

FUTURE SCIENTISTS OF AMERICA FOUNDATION
NATIONAL SCIENCE TEACHERS ASSOCIATION
1201 16th Street N. W. Washington, D. C.

The following list includes the name of each of the students winning first, second, or third place awards, the student's age and grade in school, the title of his project, his school and home town, and the name of his science teacher sponsor.

REGION I

Grades 7-8

FIRST PLACE

Minna Horovitz (12 yrs. 7th): "Research Problem in the Conduction of Heat"; Weeks Jr. H. S., Newton, Mass.; **Charles Howard.**

Irving Thomae (13 yrs. 8th) and **Janice Hopkinson** (13 yrs. 8th): "Simon, the Thinking Machine"; Thomas Willett School, Attleboro, Mass.; **Mrs. Dorothy Mulroy.**

SECOND PLACE

Janet Truman (12 yrs. 7th) and **Granger Morgan** (13 yrs. 7th): "Geysers of Yellowstone"; Hanover H. S., Hanover, N. H.; **G. E. Rothenburger.**

Gail Wells (12 yrs. 7th): "Saving Steps"; Noah Wallace School, Farmington, Conn.; **J. R. Gibson.**

Fred Roisen (12 yrs. 7th): "Is It Possible to Hatch Colored Chickens?"; Weeks Jr. H. S., Newton Center, Mass.; **Charles Howard.**

Grades 9-10

FIRST PLACE

Michael Ruttenberg (15 yrs. 10th): "Jet Engine Finish"; Boston Latin School, Boston, Mass.; **Paul Boylan.**

Alan Marshall (15 yrs. 10th): "Radio Control"; Laconia H. S., Laconia N. H.; **Howard Wagner.**

SECOND PLACE

Roger Guay (15 yrs. 9th); "Rockets & Jets"; Laconia H. S., Laconia, N. H.; **Howard Wagner.**

Barbara McMorris (14 yrs. 9th): "Mendel's Answer: Heredity"; South Jr. H. S., Pittsfield, Mass.; **Anne Nesbit.**

Carol Ditrocchio (14 yrs. 9th): "Cigarette Testing"; Noah Wallace School, Farmington, Conn.; **J. R. Gibson.**

Grades 11-12

FIRST PLACE

Robert Munroe (18 yrs. 12th): "Hydrophil Balance & Results Obtained"; Nashua Sr. H. S., Nashua, N. H.; **Marco Scheer.**

SECOND PLACE

Jeanne M. Poulin (17 yrs. 12th): "The Effects of Metals and Antibiotics on Mold Cultures"; Notre Dame H. S., Central Falls, R. I.; **Sister Marie Martinien, S. S. A.**

THIRD PLACE

Stanley Matyszewski (17 yrs. 12th): "Redox Reactions"; Fairfield College Prep., Fairfield, Conn.; **Walter Grant, S. J.**

REGION II

Grades 7-8

FIRST PLACE

Judy Proctor (13 yrs. 8th): "Effects of Colored Light on Growth of Plants"; Canastota Central School, Canastota, N. Y.; **Genevieve Lamp.**

Joel Goldstein (13 yrs. 8th): "Stimulating Plant Growth"; Long Beach Jr. H. S., Long Beach, N. Y.; **Mrs. M. B. Mayer.**

SECOND PLACE

Elvira Galavotti (13 yrs. 8th): "Narcotics and Stimulants"; Canastota Central School, Canastota, N. Y.; **Genevieve Lamp.**

Walter Ludeke (13 yrs. 8th): "Experiments in Hydroponics"; Marshall H. S., Rochester, N. Y.; **T. E. Guglin.**

Michael Cahan (12 yrs. 7th): "My Experience in Microscopy"; Pulitzer Jr. H. S., Jackson Hgts., N. Y.; **Joseph Isby.**

Grades 9-10

FIRST PLACE

Taimi Toffer (16 yrs. 10th): "Penicillin"; Allentown H. S., Allentown, Pa.; **Herbert Reichard.**

Carolyn Hansen (15 yrs. 10th): "The Effect of Testosterone Injections on Castrated White Rats"; Kenmore H. S., Kenmore, N. Y.; **Louise Schwabe.**

SECOND PLACE

Anne K. Slyer (15 yrs. 10th): "The Estrus Cycle of a Mouse"; Cathedral Academy, Albany, N. Y.; **Sister Edmund Therese.**

Roger Schneider (16 yrs. 10th): Growth and Nutrition in White Rats"; Kenmore Sr. H. S., Kenmore, N. Y.; **Louise Schwabe.**

Sander Fox (16 yrs. 10th): "The Science and Art of the Earthworm"; Rahway H. S., Rahway, N. J.; **Lee R. Yothers.**

Grades 11-12

FIRST PLACE

Felix Eger (17 yrs. 12th): "Production of Electrical Energy from Radioactive Metals (Atomic Battery)"; Stuyvesant H. S., New York, N. Y.; **Alfred Bender.**

SECOND PLACE

Stan Rosenfeld (16 yrs. 11th): "The Construction of a Professional Type Geiger Müller Counter and the Recording of the Atmospheric Radioactive Intensity in New York City"; Erasmus Hall H. S., Brooklyn, N. Y.; **James Murray.**

THIRD PLACE

Mansil Gardner (18 yrs. 11th): "A Working Model Rocket Engine"; Newton H. S., Queens, New York, N. Y.; **Louis Auerbach.**

REGION III

Grades 7-8

FIRST PLACE

Burton Holloway (14 yrs. 8th): "Traffic Control System"; MacFarland Jr. H. S., Washington, D. C.; **Betty Schaaf.**

Lynwood Heiges, Jr. (12 yrs. 7th): "Newton's Third Law of Motion"; Paul Jr. H. S., Washington, D. C.; **Dr. Berenice Lamberton.**

SECOND PLACE

Richard Armsby (12 yrs. 7th): "The Galaxy"; Alice Deal Jr. H. S., Washington, D. C.; **Mrs. Margaret Saville.**

Marcia Fratkin (13 yrs. 8th): "Inside the Crystal"; Paul Jr. H. S., Washington, D. C.; **Dr. Berenice Lamberton.**

Nathalie D. Harwood (13 yrs. 7th): "Weather Observation Station"; St. Catherine's School, Richmond, Va.; **Janet E. Whaley.**

Grades 9-10

FIRST PLACE

Robert Menzer (15 yrs. 10th): "What's on a Piling?"; Northwestern H. S., Hyattsville, Md.; **Howard B. Owens.**

Nick Pittas (15 yrs. 10th) and **Francis Cole** (16 yrs. 10th): "What's in a Log?"; Northwestern H. S., Hyattsville, Md.; **Howard B. Owens.**

SECOND PLACE

David Danoff (15 yrs. 10th): "Effects of Sex-linked Hormones Upon Fish"; Baltimore City College, Baltimore, Md.; **Jerome Denaburg.**

Robert Moore (16 yrs. 10th): "Exploring the Binary System of Mathematics"; Montgomery Blair H. S., Silver Spring, Md.; **Harold Horn.**

Jimmy Martin (15 yrs. 10th): "Circulation in the Human Body"; Oak Ridge H. S., Oak Ridge, Tenn.; **Dill B. Asher.**

Grades 11-12

FIRST PLACE

Floyd Wilson (18 yrs. 12th): "To Determine the Effect of the Plating of Various Metals on the Field Pattern of a Micro-Wave Antenna"; Booker T. Washington H. S., Norfolk, Va.; **John Perry.**

SECOND PLACE

Robert Lontz (17 yrs. 12th): "Gas Diffusion Through a Thin Plastic Membrane"; Archmere Academy, Claymont, Del.; **Rev. B. Brunette.**

THIRD PLACE

Darrell Gillespie (17 yrs. 12th): "The Costly Bite of the Sea (Metal Corrosion)"; Northwestern H. S., Hyattsville, Md.; **Nis Hansen.**

REGION IV

Grades 7-8

FIRST PLACE

Joseph H. Kagel (12 yrs. 7th): "Rocks and Minerals as a Hobby"; Miami Beach Jr. & Sr. H. S., Miami Beach, Fla.; **Elsie M. Thabit.**

Alvin Robins (13 yrs. 8th): "A New Era of Scientific Safety"; Miami Beach Jr. & Sr., H. S., Miami Beach, Fla.; **Charles Friend.**

SECOND PLACE

Ralph Murphine (13 yrs. 8th): "3-D Shadow Pictures"; North Fulton H. S., Atlanta, Ga.; **Belle Cooper.**

Rose Baumker (12 yrs. 7th): "Growth of Plant"; St. Anastasia School, Ft. Pierce, Fla.; **Sister John Maureen.**

John Molnar (13 yrs. 8th); "Collection and Classification of Shells"; St. Anastasia School, Ft. Pierce, Fla.; **Sister John Maureen.**

Grades 9-10

FIRST PLACE

James B. Dunson (14 yrs. 10th): "Identification of Microorganisms in Industrial Water"; Henry Grady H. S., Atlanta, Ga.; **Thomas H. Walton.**

Nancy Wilson (14 yrs. 9th): "Antibiotics from Soil"; Statesboro H. S., Statesboro, Ga.: **Martha Tootle.**

SECOND PLACE

Margarita Garcia (13 yrs. 9th): "Hydroponics"; Colegio Católico, Caguas, Puerto Rico; **Sister Mary Natalie.**

Antonio Longo (14 yrs. 9th); "A Study of Hormones"; Colegio Católico, Caguas, Puerto Rico; **Sister Mary Natalie.**

Robert E. Lynch (15 yrs. 10th): "Insect Collection and Development"; North Fulton H. S., Atlanta, Ga.; **Belle Cooper.**

Grades 11-12

FIRST PLACE

Charles Yulish (17 yrs. 12th): "Experiments in Tracer Studies with the Radioisotopes—P-32, Ca-45, S-35, Cr-51, and Y-91"; Miami Beach Sr. H. S., Miami Beach, Fla.; **Birdie McAllister.**

SECOND PLACE

Richard Estes (17 yrs. 12th): "A Study of the Thermal Reflectivity of Certain Metals"; Brown H. S., Atlanta, Ga.; **Col. J. E. Morris.**

THIRD PLACE

Richard Estes (17 yrs. 12th): "A Study of the Effectiveness of the Cottrell Precipitator"; Brown H. S., Atlanta, Ga.; **Col. J. E. Morris.**

REGION V

Grades 7-8

FIRST PLACE

Marjorie Hahne (13 yrs. 8th): "Trilobites"; Haven Intermediate School; Evanston, Ill.; **Louise Hollweg.**

Roger Ryan (11 yrs. 7th): "Transistors & Transistor Transmitter & Receiver"; Portage Park School, Chicago, Ill.; **Isabel M. Gray.**

PHOTO BY NEA JOURNAL

A significant part of the 1954 Program of Science Achievement Awards for Students and one which was of particular interest to the 953 entrants was the work of the regional and national judging committees. Pictured above is the national judging committee as they discuss the many interesting and thought-provoking projects. Around the table are seated from left to right: Dr. Ellis Haworth, Wilson Teachers College, Washington, D. C.; Mr. Edward S. Beach, Hyattsville Junior Highschool, Hyattsville, Md.; Miss Madeleine Skirven, Eastern Highschool, Baltimore, Md.; Mr. Robert Gould, American Chemical Society, Washington, D. C.; Dr. R. W. Mebs, National Bureau of Standards, Washington, D. C.; Dr. William Kilgore, Wilson Teachers College, Washington, D. C.; Dr. Paul Blackwood, U. S. Office of Education, Washington, D. C.; Mr. Royce Van Norman, graduate student, Catholic University, Washington, D. C.; Mr. William Gruver, Gaithersburg Highschool, Gaithersburg, Md. In the background are from left to right: Miss Helen Hale, chairman of the operating committee for the 1954 Program; Dr. John H. Woodburn, Assistant Executive Secretary NSTA; and Miss Paula Robertson, FSAF Secretary.

SECOND PLACE

Barbara Garber (13 yrs. 8th) and **Jean Luedecke** (14 yrs. 8th): "Tree Growth"; Emerson Jr. H. S., Lakewood, Ohio; **Alton Yarian.**

Daniel Vucovich (12 yrs. 7th): "Rocks of Different Types"; Parker Elementary, Chicago, Ill.; **John F. Etten.**

Stephen Burns (13 yrs. 8th): "Investigation of Supposed Meteor Crater"; Romeo H. S., Romeo, Mich.; **Mrs. Mary Tapley.**

Grades 9-10

FIRST PLACE

Robert Ware (15 yrs. 9th): "The Construction and Use of Centroids"; Test Jr. H. S., Richmond, Ind.; **Elmer Cudworth.**

Geoff Baker (15 yrs. 9th): "Diet Study of the Long-Eared Owl"; New Castle H. S., New Castle, Ind.; **Mary E. Rankin.**

SECOND PLACE

Paul Pearson (14 yrs. 9th): "The Operational Theory of Disc Type Television"; Highland Park H. S., Highland Park, Ill., **H. Everett Hanson.**

Neil Davidson (14 yrs. 9th): "Microscope"; Roxboro Jr. H. S., Cleveland Hgts., Ohio; **W. Edgar Glenn.**

Willis Hill (16 yrs. 10th): "The Effects of Ultra-Violet, Infra-Red, White, Red, Blue, Green, and Yellow Lights on Plant Tissues"; Woodward H. S., Cincinnati, Ohio; **Gordon Woodward.**

Grades 11-12

FIRST PLACE

Karl Landstrom (16 yrs. 11th): "From Bauxite to Aluminum"; Chillicothe H. S., Chillicothe, Ohio; **Harold E. Wilson.**

SECOND PLACE

Cleris Svetlik (16 yrs. 11th): "Television Camera"; Shaker Hgts. H. S., Cleveland, Ohio; **Theodore Buergler.**

THIRD PLACE

Wayne M. Martin (18 yrs. 12th): "The Effect of Bullet Shape on Bullet Velocity"; Thomas Carr Howe H. S., Indianapolis, Ind.; **Richard Hammond.**

REGION VI

Grades 7-8

SECOND PLACE

Michael Munger (13 yrs. 8th): "Tin Can Planetarium"; Irving Jr. H. S., Lincoln, Nebr.; **Henry Goebel.**

Grades 9-10

FIRST PLACE

Gregory Beaver (15 yrs. 10th): "The Study of the Chick Embryo"; Bemidji H. S., Bemidji, Minn.; **Maryls Torgrimson.**

John E. Kreznar (15 yrs. 10th): "Radio Control System"; Shorewood H. S., Shorewood, Wisc.; **Norman Suchanek.**

SECOND PLACE

James Zuelow (14 yrs. 9th): "Insects of Northern Minnesota"; Bemidji Jr. H. S., Bemidji, Minn.; **Mrs. Effie Mercier.**

Sharon McIntyre (15 yrs. 9th): "The Water Cycle"; Central School, Grafton, N. Dak.; **Harold Bliss.**

Gary Kaziukewicz (14 yrs. 9th): "Caffeine Content in Cocoa, Coffee, and Tea"; DePadua H. S., Ashland, Wisc.; **Sister Dolorosa.**

Grades 11-12

FIRST PLACE

Thomas Weidenhopf (17 yrs. 11th): "An Experimental Transistor Radio"; Aquinas H. S., La Crosse, Wisc.; **Sister M. Theola.**

SECOND PLACE

Curtis Westley (17 yrs. 12th): "Removal of Rust by Electrolytic Process"; Central H. S., Aberdeen, S. Dak.; **Thomas Loverude.**

THIRD PLACE

Robert L. Randall (17 yrs. 12th): "Diazonium Compound Photography"; Central H. S., Aberdeen, S. Dak.; **Thomas Loverude.**

REGION VII

Grades 7-8

FIRST PLACE

John Gehrs (13 yrs. 8th): "Simple Celestial Determination of Longitude and Latitude"; Chaffee Jr. H. S., Chaffee, Mo.; **Charles A. Goddard.**

Roger Hall (14 yrs. 8th): "Dissection"; Roosevelt Jr. H. S., Coffeyville, Kans.; **Jennie K. Macoubrie.**

SECOND PLACE

Danny Cloud (8th): "Rotary Drilling Rig"; Norman Jr. H. S., Norman, Okla.; **Neal Vick.**

Mead Wyman (13 yrs. 8th): "Production of Lithopone"; Roosevelt Jr. H. S., Coffeyville, Kans.; **Jennie Macoubrie.**

Gene Harmon (13 yrs. 8th): "Principles of Refrigeration"; Webster Jr. H. S., Oklahoma City, Okla.; **Freda O'Neal.**

Grades 9-10

FIRST PLACE

Rita Fuesling (16 yrs. 10th): "Phenylhydrazine and Cobalt Chloride Effects on the Hemoglobin Percentage, Red Blood Cell Count, and Coagulation Time in Rabbits"; Galena Park Sr. H. S., Galena Park, Texas; **Mrs. Joyce Thompson.**

Weldon Whitlow (15 yrs. 10th) and **Gary Prideaux** (14 yrs. 9th): "Planetarium"; Garland Jr. H. S., Garland, Texas; **Mrs. Ruth Peters.**

SECOND PLACE

Susan Fisher (15 yrs. 10th): "Soil Conservation"; Pueblo Catholic H. S., Pueblo, Colo.; **Sister Aquinas.**

Gary Losh (14 yrs. 9th): "Meteorology"; Roosevelt Jr. H. S., Coffeyville, Kans.; **Jennie Macoubrie.**

Robert Moore (15 yrs. 9th): "Astronomy"; Roosevelt Jr. H. S., Coffeyville, Kans.; **Jennie Macoubrie.**

Grades 11-12

FIRST PLACE

Robert Blanks (17 yrs. 12th): "A Chemical Alarm Clock"; South H. S., Denver, Colo.; **Wilfred W. Miller.**

SECOND PLACE

Eleanor Millard (15 yrs. 11th): "The Determination of the Optimum Acidity for the Separation of Mn, Ni, Fe, and Zn Ions by Paper Chromatography"; Austin H. S., Austin, Texas; **Mrs. Edna Boon.**

THIRD PLACE

Robert A. Kurz (16 yrs. 11th): "The PH Meter, Its Operation and Use"; Christian Brothers H. S., St. Louis, Mo.; **Brother J. Henry, F.S.C.**

REGION VIII

Grades 7-8

FIRST PLACE

Richard Haws (13 yrs. 8th): "The Rate of Learning of Rats"; Edmond S. Meany Jr. H. S., Seattle, Wash.; **V. F. Kent.**

Bernard Uribe (13 yrs. 8th): "A Seismograph"; Wilson Jr. H. S., Oakland, Calif.; **Maurice Phelan.**

SECOND PLACE

Joe Schleef (13 yrs. 8th): "Callisto, A New World"; Bird Street School, Oroville, Calif.; **Mrs. Sonia Hubbard.**

Ann Megorden (13 yrs. 8th): "The Dynamo"; Lindbergh Jr. H. S., Long Beach, Calif.; **Francis St. Lawrence.**

David Minor (14 yrs. 9th) and **Hideo Kamimoto** (13 yrs. 8th): "Radio Controlled Boat"; Wilson Jr. H. S., Oakland, Calif.; **Maurice Phelan.**

Grades 9-10

FIRST PLACE

Paul Lipton (14 yrs. 10th): "Home-Made Oscilloscope"; Antioch H. S., Antioch, Calif., **Lawrence Stringari.**

Carl Lemke (16 yrs. 10th): "Solar Furnace"; Eugene H. S., Eugene, Ore.; **Ralph Collins.**

SECOND PLACE

Kyrk Dennis Reid (15 yrs. 10th): "A Progress Report on My Cultures of *Pseudomonas Fluorescens*"; Carmel H. S., Carmel, Calif.; **Enid Larson.**

Patricia Hall (14 yrs. 9th): "Seismograph"; Lindbergh Jr. H. S., Long Beach, Calif.; **F. J. St. Lawrence.**

Paul Johnson (16 yrs. 10th): "Fungi on Trees in the San Francisco Bay Area"; San Leandro H. S., San Leandro, Calif.; **Mr. Wycoff.**

Grades 11-12

FIRST PLACE

Morris Bol (17 yrs. 12th): "Cadmium Plating"; Palo Alto Sr. H. S., Palo Alto, Calif.; **Paul Engelcke.**

SECOND PLACE

John Wright (17 yrs. 11th): "Thermit Reactions with Various Metallic Oxides"; Tamalpais H. S., Mill Valley, Calif.; **Ray Palmer.**

THIRD PLACE (Tie)

Dave Hirte (17 yrs. 11th): "Electric Furnace and Products"; Lewis and Clark H. S., Spokane, Wash.; **H. M. Louderback.**

Jerry Myers (16 yrs. 11th): "Study of Blood"; North Phoenix H. S., Phoenix, Ariz.; **Gladys Neil.**

1954 Winners

Recognition Awards for Science Teachers

Four teachers came up with the "best science teaching ideas" of the year to become winners in the third annual Program of Recognition Awards for Science Teachers. Ten other participants were cited for honorable mention.

Dr. William H. Eisenman, Secretary of the American Society for Metals which sponsors the program under the Future Scientists of America Foundation, presented the awards at the banquet meeting of the Annual Convention of the National Science Teachers Association held in Chicago on April 2. The first place award of $400 went to Edward Victor, head of the science department of Rogers High School, Newport, Rhode Island. With the aid of his fellow teachers, Victor was able to analyze the study troubles which his science students encountered and to develop teaching methods that help students improve their study habits.

Maurice Bleifeld of Newtown High School, Elmhurst, New York, reported how he has used the discoveries and inventions of great scientists to show his students how scientists approach and solve problems. He received the second place $300 award. Mr. Bleifeld had been a winner in the 1953 program. Phyllis Busch, biology teacher in the Abraham Lincoln School in Brooklyn, New York, also a winner in 1953, was recognized with the $200 third place award for her story of how she converted a vacant city lot into a source of field experience thought to be available only to boys and girls in suburban or country schools. Stanley C. Pearson, assistant curriculum coordinator, math and science, Pasadena City Schools, California, received the fourth place award of $100 for his idea which featured easily-constructed paper models that help students make sense out of abstract mathematical concepts. He devised paper gadgets to help him teach many of the topics in physics that ordinarily require elaborate equipment. For example, the problem of determining the meeting point of two vehicles which start from opposite ends of a road and proceed toward each other can be solved by his "rapid grapher" made of tagboard and colored yarns. Quoting Pearson, "The number of audio-visual aids that can be created from paper seems to be limited only by the amount of cutting, folding, and gluing that a person is willing to do."

This year's judging committee was headed by Mr. Edward W. Savery, Friends School, Wilmington, Delaware, and had the following members: Dr. L. Eugene Cronin, University of Delaware; Dr. W. E. Lusby, E. I. duPont de Nemours and Co.; Dr. L. A. Wetlaufer of the American Society for Metals and duPont; Miss Dorothy A. Baugher, Friends School, Wilmington; Miss Matilda M. Ernst, Tower Hill School, Wilmington; Mr. Wilfred Miller, P. S. duPont High School, Wilmington; Mr. Earl Williamson, Northeast High School, Philadelphia; and Miss Paula Robertson, NSTA headquarters office. The committee found its task unusually difficult because of the impressive quality of the entries. Each paper presented a practical and ingenious teaching idea. Sharing these ideas should help other teachers do more of the kind of teaching that will keep capable boys and girls in the paths that can lead to engineering and scientific careers.

The following listing gives a brief summary of each of the ten honorable mention papers and the names of the other entrants together with their schools, teaching positions, and the titles of their projects. Because of the unique value of each entry, it is regretted that there is not space to summarize all papers.

Barquist, Carmelita. (HM) Biology teacher, Salem High School, Salem, Oregon. "Projects A-Popping." A report of ingenious models made of balsa wood, papier maché, and wood, plus other original projects including musical compositions is presented with excellent color photographs.

Brockenbrough, Harriet Scott. (HM) Chemistry teacher, Hermitage High School, Richmond, Virginia. "Teaching Practical Chemistry in College Preparatory Classes." Student committees prepare bulletin board displays of the practical aspects of chemistry. Research for the displays takes them far afield from the classroom to industrial laboratories, hospitals and governmental agencies.

Geiber, Jeanne L. and **Hodges, Edith S.** (HM) Chemistry and biology teachers, Robert E. Lee Senior High School, Baytown, Texas. "Tomorrow's Scientists: Test Tube Shakers Club." These two teachers sponsor a science club where field trips, demonstrations, lectures, student programs, and social activities provide vital experiences. Under their aegis, club membership has risen from 8 to 129.

George, Brother Julius, F.S.C. (HM) Physics instructor, De La Salle Institute, Chicago, Illinois. "Radio Experiments in the Physics Lab." The "block technique" of modern radio courses is introduced into the radio phase of the physics laboratories. Brother Julius constantly tries to keep the laboratory work of his students meaningful and in tune with what his students see modern scientists doing.

Goldstein, Philip. (HM) Chairman, Biology Department, Abraham Lincoln High School, Brooklyn, New York. "Self-Diagnosis: A Testing Technique." Goldstein has designed tests that not only measure a student's achievement but also bring into focus, both for the teacher and the student, subjects or topics in which the instruction or study has been inadequate.

Kahme, Flora. (HM) Teacher, general and physical science, Port Jefferson Elementary School, Long Island, New York. "Model of a Commutator." The commutator of a small demonstration motor was enlarged so "small fry" could readily observe its action. Other laboratory and demonstration equipment has been remodeled to serve the specific purposes in Miss Kahme's situation.

Miller, Roy L. (HM) Physics teacher, Hunter College High School, New York City. "Our Wednesday Afternoons." The report describes the series of trips to ice plants, the bureau of standards of a large department store, observatories, weather stations, hospitals, and other places in the New York area. Miller capitalizes on all opportunities to have his students understand and appreciate the interrelationships between science and other fields of human endeavor.

Morris, Col. J. Edgar. (HM) Science teacher, Brown Community High School, Atlanta, Georgia. "An Honors Science Program in a Community High School." Beginning in the second semester of the ninth grade, capable students are placed in special honors classes. Offerings are adjusted so that the basic material is covered in a shorter time than in the regular classes, and special projects are carried out by the gifted students.

Molkenbur, Robert. (HM) Chemistry teacher, Central High School, St. Paul, Minnesota. "A Chemistry Program: Not Just A Class." The enrollment in chemistry was increased by setting up parallel chemistry courses, improving the chemistry club program, and introducing a series of annual chemistry field trips. Molkenbur meets the competition from glamorous and exotic careers by adjusting the chemistry offerings to the evolving interests of the students and the changing cultural and vocational patterns in the community.

Nelson, Clifford R. (HM) General science teacher, J. W. Weeks Junior High School, Needham, Massachusetts. "A Technique for Measuring the Ability of a Pupil to Read Science Materials With Speed and Understanding." Recognition that reading is a skill basic to the success of any pupil in science prompted Nelson to devise a method for analyzing students' abilities to grasp science materials. His test, given to ninth-graders, can be scored either to show comprehension or to indicate a combination of comprehension and speed.

Isidor Auerbach. Thomas Jefferson H. S., Brooklyn, N. Y. "The Fluorescent Lamp as a Teaching Device".

Louis Auerbach. Chairman, Physical Science Dept., Newtown H. S., Elmhurst, N. Y. "Meaningful Student Research Projects".

John J. Baccelli. Balboa H. S., San Francisco, Calif. "Cut-Outs as an Aid to Learning".

Thomas L. Bagshaw. Science instructor, Weeks Jr. H. S., Newton, Mass. "Elements of a Constructed Functional Unit". "Construction of a Ripple Tank: A Demonstration of Sound Waves". "Construction of a Wind Tunnel".

Thomas L. Bagshaw. Science instructor, Weeks Jr. H. S., Newton, Mass., and **Robert D. MacCurdy,** Science teacher, The Senior H. S., Watertown, Mass. "Are Science Fair Judgments Fair?".

Andrew Baldwin. Harris School, Chicago, Ill. "Student Fiction".

Mrs. Wilma E. Ballard. Science teacher, Maury H. S., Norfolk, Va. "Teaching the Principles of Human Behavior to High School Students".

David Bengelsdorf. Consultant, elementary science, instructor, Jr. H. S. Science, White Plains, N. Y. "Science for the Elementary School".

Wendell F. Bennett. Head, Science Dept., Natick Sr. H. S., Natick, Mass. "Pupils Teach the Public Atomic Energy".

Emily E. Boggs, Jane K. Bonney, Dorothy Ianora. Physical Science Dept., Hunter College H. S., New York, N. Y. "The Constellation Room".

Paul J. Boylan. Master, Science Dept., Boston Latin School, Boston, Mass. "Arousing Interest in High School Fairs at the Junior High School Level".

Nettie Bradford. Biology teacher, West H. S., Salt Lake City, Utah. "A Novel Presentation for the Orientation in Science".

Lawrence E. Bromberick. Chemistry teacher, Mt. Lebanon H. S., Pittsburgh, Pa. "The Degree of Acidity (pH) of Common Solutions".

Annie Sue Brown. Science coordinator, Board of Education, Atlanta, Ga. "Ways to Encourage Closer Cooperation between Science Teachers and Students in High Schools and Science-Related Enterprises in the Community".

George S. Buck. Physics teacher, Towson H. S., Baltimore County, Md. "A Study of the Inclined Plane".

Walter M. Bybee. Principal & science teacher, Death Valley Union H. S., Shoshone, Calif. "General Science Comes Alive as a Vocational Science".

Elizabeth F. Cadle. Science instructor, Senior H. S., Springfield, Mo. Teaching About the Human Body (no title given by entrant).

Mrs. Nedra Callard. Science teacher, Painted Post H. S., Painted Post, N. Y. "We Meet Our Forest Ranger".

Joseph F. Castka. Science Dept., Lafayette H. S., Brooklyn, N. Y. "Unit on Oxidation—Reduction with Demonstrations".

Grace B. Coffin. Teacher of general science, Fifth St. Jr. H. S., Bangor, Me. "The File Drawer—Efficient Help for the Science Teacher".

Gerhard H. Coler. Science instructor, Bullard-Havens Tech. Sch., Bridgeport, Conn. "A Sample Lesson in Chemistry for the Plumbing Trade".

Mrs. Anna B. Collard. Supervisor of science, Winthrop Training Sch., Rock Hill, S. C. "Building an Advanced Science Course Cooperatively".

Belle B. Cooper. North Fulton H. S., Atlanta, Ga. "The Group Method of Teaching General Science".

Myrtle Creaser. Central Jr. H. S., Kenosha, Wis. and Pellston H. S., Pellston, Mich. "Teaching Appreciation of Scientists".

Larry Cudney and **Mark Smith.** La Cumbre Jr. H. S., Santa Barbara, Calif. "It's a Basic Machine".

Charlie Deaton. Science teacher, Lanier Sr. H. S., Macon, Ga. "Stimulating Original Thought".

William F. Dresia. San Rafael H. S., San Rafael, Calif. "A Class Project on Meteorology".

Ruth Essig. Inglewood, Calif. "Energy for Children".

John F. Etten. Science teacher, Parker Elem. Sch., Chicago, Ill. Science Magazine Rack (no title given by entrant).

Mrs. Bessie V. Fairley. Opelousas, La. "New Ideas in Science Teaching".

Mrs. Alpha H. Fifer. Carson City, Nev. "Transportation Unit—Study Unit". "Aviation Education Unit".

Miss Ewaugh Finney. Mathematics and science instructor, Treutlen County Training Sch., Soperton, Ga. "Ways to Meet the Needs of Boys and Girls of Rural Schools When There Are Limitations on Pupil Aptitudes and Equipment".

Robert L. Gantert and **Elmo Little:** Science Dept., Alexander Hamilton Jr. H. S., Seattle, Wash. "Unit Lesson on Behavior Patterns of Mice".

Jack Fishleder. Science teacher, Wickenburg H. S., Wickenburg, Ariz. Color slides of classroom demonstrations, student projects, and illustrative material (no title given by entrant).

Irwin H. Gawley. Chemistry teacher, Tenafly H. S., Tenafly, N. J. "Advanced High School Chemistry for the Better Student".

Mrs. Carolyn A. Gibson. West View H. S., Pittsburgh, Pa. "Biology at Work".

Mrs. Pauleen Green. Biology teacher, Dumas H. S., Dumas, Texas. "To Make Biology Meaningful".

John W. Greenwalt, Bryce M. Rowland, S. W. Davidson. Roosevelt Jr. H. S., Cleveland Hgts., Ohio. "Showing Teaching Techniques in Science Curriculum Meetings".

Mrs. Margaret D. Gunter. Science Dept., Jordan Voc. H. S., Columbus, Ga. "Guidance Techniques Effective in Increasing Enrollment in Chemistry".

John O. Hall. General science teacher, Mansfeld Jr. H. S., Tucson, Ariz. "Quiz Programs". "Hobby Show".

Richard W. Hammond. Thomas Carr Howe H. S., Indianapolis, Ind. "Techniques for Physics Classes to Emphasize Scientific Attitude".

Dorothy Harlow. Rockville H. S., Rockville, Conn. "Individual Projects in the Classroom".

Mrs. Cecile J. Harriman. Teacher of seventh grade, Wiley Sch. Winston-Salem, N. C. "Science".

Grace M. Heacock. Director of science, Cleveland Hill H. S., Buffalo, N. Y. "Science Unlimited".

E. Leila Helmick. New Philadelphia H. S., Sr. Div., New Philadelphia, Ohio. "A Proved Teaching Technique for Chemistry".

Katherine Hertzka. Hoke Smith H. S., Atlanta, Ga. "A Learning Situation in Human Biology—Introducing the Study of Respiration".

Fern Johnson. Santa Barbara H. S., Santa Barbara, Calif. "A Biology Unit that Never Fails".

Vivla Johnson. General science teacher, Norman Jr. H. S., Norman, Okla. "Ways to Meet the Needs, Limitations, or Facilities of Special Groups of Boys and Girls".

Wayne H. Kincaid. Physical science teacher, Emmerich Manual Training H. S., Indianapolis, Ind. "The Coriolis Effect".

Thomas H. Knepp. Stroudsburg H. S., Stroudsburg, Pa. "A School Orchard—An Outdoor Laboratory".

Paul R. Laake. Seabrook Jr. H. S., Seabrook, Texas. "Bring Industry into the Classroom".

Clifford La Roge Chairman, Science Dept., Normandy H. S., St. Louis County, Mo. "An Excursion to the St. Louis Zoo".

Alfred Lazow. Science teacher, Haven Jr. H. S., Evanston, Ill. "Science Teaching Idea".

Robert B. Leitch. Lincoln Jr. H. S., Santa Monica, Calif. "The Third Dimensional Approach to Learning Science".

Mrs. Emilie U. Lepthien. Supervisor, Div. of Visual Educ., Board of Educ., Chicago, Ill. "Studying Nuclear Energy in the Seventh and Eighth Grades".

Milton S. Lesser. Biology Dept., Jefferson H. S., Brooklyn, N. Y. "Scientific Thinking—Detective Story".

Mrs. Carle G. Libby. Teacher of general science & chemistry, Baton Rouge H. S., Baton Rouge, La. "A Plan for Encouraging Students to Enroll in Science Courses".

Robert D. MacCurdy. The Senior H. S., Watertown, Mass. "Characteristics of Superior Science Students and Factors that Have Led to Their Development".

Robert D. MacCurdy, Virginia M. Murphy, Alfred A. Adams, Carlo Vacca. The Senior H. S., Watertown, Mass. "Can We Teach Them How to Study?".

Norman J. MacDonald. Coordinator of science and civil defense, School Dist. of the City of Erie, Pa. "Science Corner".

George F. McCahey. Science teacher, Mt. Pleasant H. S., Providence, R. I. "The Future White Caps of Mount Pleasant High".

Robert C. McCafferty. Biology teacher. Central H. S., Wadsworth, Ohio. "The Work Conference—A Technique for Teaching Health".

Mrs. Violet McLauren. San Leandro H. S., San Leandro, Calif. "National Parks & Forests Unit".

Bernard F. McNish. Biology teacher, Elizabeth-Forward H. S., Elizabeth, Pa. "Unit—Insects".

Charles J. Migliazzo. Science teacher, Huntington Park H. S., Huntington Park, Calif. "Organization of a Unit on Narcotics".

Mrs. Maude C. Miller. Howard H. S., Georgetown, S. C. "How Pupils Learn".

Ray W. Moore. Milford-Mill H. S., Baltimore, Md. "Making the Biology Laboratory LIVE".

Norma Munson. Detroit Lakes, Minn. "Youth Needs Science Today".

S. M. Pattee. Roosevelt H. S., Cedar Rapids, Iowa. "Boy Scouts Make Fine Teaching Assistants".

Fred T. Pregger. Physics teacher, and **Frank X. Sutman.** Chemistry teacher, West Orange H. S., West Orange, N. J. "A Method of Stimulating Interest in Science on the Elementary School Level and of Stimulating Interest in the Teaching of Science on the High School Level".

Herbert H. Reichard. Allentown H. S., Allentown, Pa. "A Story in Pictures of the Seventh Lehigh Valley Science Fair and the Trip to the National Science Fair at Oak Ridge, Tennessee, 1953".

Charles L. Rich. Science instructor, Lovelady H. S., Lovelady, Texas. "A Coordinated Science Program for a Rural Community School System".

Esther Rivkin. General science teacher, Benjamin Franklin Jr. H. S., Baltimore, Md. "Science Award Presentation as a Means of Stimulating Interest".

James A. Robb. Junior H. S., Newport, Ark. "What Happens to Creativity?".

C. E. Rothenburger. Science teacher, Hanover H. S., Hanover, N. H. "Senior and Junior High Project Day".

Mrs. Ethel Russell. Jennings, Fla. "Flying Saucers".

Francis St. Lawrence. Chairman, Science Dept., Lindbergh Jr. H. S., Long Beach, Calif. "Science Projects for Superior Students".

Mrs. Miriam G. Schoenherr. North Quincy H. S., North Quincy, Mass. "Diarama".

Hazel Seddon. Science Dept., Senior H. S., Springfield, Mo. "Student Laboratory Assistants—Boon of the Busy Science Teacher".

Roy E. Sheppard. Physical science instructor, Mattoon H. S., Mattoon, Ill. "What Do You Teach?".

Elizabeth A. Simendinger. Belmont Blvd. Sch., Elmont, N. Y. "What, No Science Room?".

Sr. Mary Aelred, O.S.F. St. Wendelin H. S., Pittsburgh, Pa. "A Food Convention".

Sr. Mary Dorothy Furey, O.S.U., M.S. Biology and chemistry teacher, St. Ursula Academy, Toledo, Ohio. "Pillows—Milkweed, Cat-Tail, Pine".

Sr. M. Hilary, O.P. St. Agnes Acad., Houston, Texas. "Related Content Material in Physics and Pre-Flight Aeronautics".

Sr. M. Jane Frances. Our Lady of Mercy H. S., Rochester, N. Y. "A Method of Curriculum Arrangement for the Average and Below Average Student".

Sr. Miriam Rosaire, C.I.M. Shenandoah Catholic H. S., Shenandoah, Pa. "Using Visual Aids".

Althea Smith Griffin, Ga. "Cooperation Between a Science Department and Science-Related Enterprises in the Community".

Wm. M. Smith. Biology teacher, Thomas Carr Howe H. S., Indianapolis, Ind. "Advanced Biology for the Senior High School".

Maude F. Snyder. Physics instructor, Carter H. S., Strawberry Plains, Tenn. "Midget Jet Auto Races for Physics Classes".

Kenneth D. Spaulding. Science teacher, Greater Boston Acad., Boston, Mass. "Science Interests in High School".

Perry N. Spelbrink. Science instructor, Corvallis H. S., Corvallis, Ore. "Showing Structural Formulas of Organic Compounds by Use of the Flannel Board".

Violet Strahler. Dayton, Ohio. "A Science Teacher and a Ford Foundation Fellowship".

Lawrence S. Stringari. Chemistry and physics instructor, Antioch H. S., Antioch, Calif. "Atom Model".

Anne Sutton. Hunter College H. S., New York, N. Y. "A Simple and Dramatic Way to Demonstrate Some of the Practical Applications of the Convex Lens".

Sara Sutton. Fulton H. S., Atlanta, Ga. "A New Approach to a Science Unit on Water".

Wanda B. Thomas. General science teacher, Utica Free Academy, Utica, N. Y. "An Easy Way to Teach Relative Humidity".

Mrs. Reuel Thompson, Jr. Galena Park Sr. H. S., Galena Park, Texas. "Three Effective Techniques in Teaching Science".

Mrs. Louise Van Der Brock. Abraham Lincoln H. S., Brooklyn, N. Y. "The Science of Home Economics".

Margaret B. Watt. Science teacher, Reno H. S., Reno, Nev. "A Teacher's Hobby—Making a Methods Collection".

C. R. Wentland. Supervising teacher, Oneida Co., Rhinelander, Wis. "Amateur Radio Removed the Four Walls of Classrooms".

Harold A. Whitney. Chairman, science and mathematics, Haaren H. S., New York, N. Y. Approach to teaching ionization theory and hydrolysis. (no title given by entrant)

Julian K. Wilson. Science teacher, John Sutter Jr. H. S., Los Angeles, Calif. "Some Specific Suggestions for Planning & Producing an Educational Television Show". "Making Cells in 3-D from a Sheet of Paper".

Fred H. Wise. Hazen, Pa. "Practical Science for the High School".

Lillian Wyckoff. Head of the Science Dept., The Baldwin Sch., Bryn Mawr, Pa. "An Experimental Course in Seventh Grade Science and Mathematics".

J. Ross Young. Chemistry teacher, Cambridge Comm. H. S., Cambridge, Ill. "A Laboratory Learning Stimulus".

F. De Witt Zuerner. Supt., No. Braddock Pub. Schs., Braddock, Pa. Trip to industry (no title given by entrant).

1954 Winners

FSA Student Chart Making Contest

The participating students and their teachers are to be commended for making the FSA Student Chart Contest a success. The Foundation expresses the thanks of all to the W. M. Welch Scientific Company, the judges who made the preliminary selections, and to the many other people who aided in planning and conducting the activity. We are especially grateful to Mr. Hugh Brown who so capably represented the sponsor.

This program provided awards for 14 students who showed outstanding ability in portraying scientific principles graphically. Entries came from 106 schools in 30 states, District of Columbia and Puerto Rico and a total of 452 charts were submitted. Registrants at the NSTA Convention in Chicago selected the following winners from the 40 charts exhibited.

(Student's name, school, title of project, and teacher)

FIRST PLACE:

Dian Smoyer; Parkland H. S., Allentown, Pa.; "How the Earth's Surface Changes"; Raymond H. Leibenguth.

SECOND PLACE:

Norma Cipriano; Notre Dame H. S., Maylan, Pa.; "Photosynthesis"; Sr. Catherine Virginia.

THIRD PLACE (tie):

August Schug; Central Catholic H. S., Toledo, Ohio; "Chemical and Radio Activity"; Sr. M. Patricia.

Elizabeth Walton; Salem Sr. H. S., Salem, Oregon; "Beebe's 1934 Bathysphere Descent"; Carmalita Barquist.

HONORABLE MENTION:

Larry Lewis; Northwestern H. S., Hyattsville, Md.; "A Typical Food Chain"; Howard Owen.

Barbara Wiessler; Parkland H. S., Allentown, Pa.; "Evolution of the Horse"; Raymond H. Leibenguth.

June Macurdy; The Senior H. S., Watertown, Mass.; "Life Cycle of a True Fern—Polypodium"; Robert MacCurdy.

Jean McCubbin; Presidio Jr. H. S., San Francisco, Calif.; "Erosion"; Julian B. Roth.

Robert Calvetti; Marquette H. S.; Ottawa, Ill.; "Ionization and Electrolysis of NaCl"; Sr. Mary Edgar, R.S.M.

Martina M. Basilio; Nazareth Acadamy, Rochester, N. Y.; "Evolution of the Microscope"; Sr. Christine Francis.

Judy Williams; Notre Dame H. S.; Maylan, Pa.; "To Determine the Solubility of a Gas"; Sr. Catherine Virginia.

George Coad; Acaalanes Union H. S., Lafayette, Calif.; "Nuclear and Chemical Action"; M. Nicholson.

Bob Armsby; Woodrow Wilson H. S., Washington, D. C.; "Protective Coloration"; Jane E. Crawford.

Marjorie Blyth; The Senior H. S., Watertown, Mass.; "Osmosis, What Is It?"; Robert MacCurdy.

Book Reviews

MISS PICKERELL AND THE GEIGER COUNTER. Ellen MacGregor. 123 pp. $2.25. Whittlesey House. McGraw-Hill Book Company, Inc. New York. 1953.

Miss MacGregor has met with substantial success in meeting the difficult task of blending good story-telling with sound science for the nine to twelve year old reading audience. The challenge to the writer of this type of book is to have the science emerge naturally from the actions and interactions of the characters. This comes through only moderately well here since the bulk of the science material woven into the story appears in the latter third of the book. However, the degree of successful integration of story with science is high enough to insure enjoyable reading.

The science content itself deals mostly with the area of atomic physics. Such concepts and topics as the half-life period of a radio-active element, radio-carbon dating, the use of tracers in biological research and the necessity for controls in experiments are briefly, clearly and adequately described for a story-science book.

Although Miss Pickerell herself is portrayed as a kindly, sympathetic, friendly old soul, it is just a little disquieting to find that again a scientist, or one friendly to science and fascinated by it is depicted as an eccentric. Miss Pickerell, with her pet cow that she is taking by steamboat for an annual physical checkup, and who awakens every two hours during the night to check on the health of the animal is hardly a likely model with which the reader may identify or "heroine-worship." Such a personality as Miss Pickerell may be dramatically desirable in attracting interest for a narrative, but protagonists with more realistic attributes would seem to be equally desirable.

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MORE POWER TO YOU. Herman & Nina Schneider. 128 pp. $2.50. William R. Scott, Inc. New York. 1953.

This very attractive book, for 9-12 year-olds, relates the history of the numerous discoveries and inventions that have led to man's mastery of the various "muscle-saving" forms of energy.

Although the history of man's harnessing of running water, wind, steam, gasoline, oil, electricity, and atomic energy is not new, the Schneiders' have succeeded in bringing into the story a challenge, freshness, and significance seldom achieved in a child's book.

Through the media of text, delightful illustrations, and simply-designed experiments, the book provides opportunities for growth in certain scientific attitudes and in an understanding of science.

However, the reviewer feels that the book would have been improved by more careful editing. The implied meanings of certain words and concepts are misleading. For example, the emphasis of the story is upon "muscle-savers," or *forces* that make man's work easier and not upon the *rate* of doing work. Yet, in almost every case, throughout the book the authors use the work *power* when the context requires the use of either the word *energy* or the word *force*.

Several experiments included in this volume are either impractical or disappointing. How many children have access to a teakettle like the one shown on Page 36 and 42? Won't the children be disappointed when they find that they can't get the results shown in the experiments on Pages 76, 77, and 78?

JUNE E. LEWIS
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CURIOUS CREATURES. Erna Pinner. 256 pp. $4.75. Philosophical Library. New York. 1953.

To the trained biologist, "Curious Creatures" offers little information which is new. However, the book compounds into one work the known data relative to many of the world's organisms which possess oddities of body structure or behavior. The book's content includes the immense ecological drama centered about these exotic creatures in their struggle for food, protection, and propagation. Here, one learns about four-footed animals which fly and birds which cannot fly; animals which live upside down and those which employ camouflage. Erna Pinner's account of symbiotic and parasitic associations might well carry lessons applicable to human society. The book contains exact descriptions and scientific explanations of the trap-door spider, elf owl, ostrich, angler fish, duck bill, dodo, walking leaf insect, bats, whales, gorillas, and many other animals.

Two features of this book deserve comment with emphasis. The author includes the scientific names of the plant and animal species which she discusses. These will serve as a ready reference to the reader who wishes to extend his knowledge beyond the scope of this book. Secondly, the numerous drawings are skillfully done and fascinating to study. This aspect alone makes the book one of interest and value.

LEE R. YOTHERS
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PRACTICAL TAXIDERMY. John W. Moyer. 126 pp. $3.00. The Ronald Press Company. New York. 1953.

Practical Taxidermy is intended chiefly for those who have had no previous training in this work, yet trained taxidermists may gain valuable hints from the book. The author is highly skilled in his art and gives freely of his secrets. He is a recognized expert in taxidermy and a staff member of The Field Museum of Natural History in Chicago.

The book is complete from the collecting of a specimen to the finished mount. The language is simple and clear and the various processes which are outlined are made doubly clear by the use of more than a hundred splendid illustrations. The work covers a wide variety of subjects, including small mammals, birds, fish, reptiles, amphibia, and on up to game heads, rugs, and entire large game mounts. A discussion of the early history of taxidermy makes an interesting introduction to the book. Suggestions for collecting, best tools to use, and best formulas are concise leaving most of the book for the study of mounting processes. The list of companies that supply taxidermy material might well be expanded to specify what each company handles for not all dealers in taxidermy supplies handle a complete line.

This book should be a boon to the sportsman who wants to prepare his own mounts. It is also valuable for the collector who does not care to prepare his own mounts but who can not get his trophy to a taxidermist for perhaps several days and must know how to care for a trophy before it reaches the taxidermist. The sportsman who uses this book will find it a joy from the start and increasingly so as skill in mounting develops through experience in this fascinating work.

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BEYOND THE GERM THEORY—THE ROLE OF DEPRIVATION AND STRESS IN HEALTH AND DISEASE. Iago Galdston, Editor. A New York Academy of Medicine Book. Health Education Council. New York. 1954.

Progress in any field of science is marked by the interaction of two processes: the discovery of fact, and the formulation of theory. With further increase in knowledge and experience, come new insights of broader scope which tend to relate previously disparate theories. Theories are synthesized, as it were, into broader and more inclusive understandings. Such a synthesis of theory is adumbrated in the collection of nine papers that make up this book.

In this synthesis, the central idea is that the living organism maintains an internal environment of stability in the face of a relatively variable outside environment. Inside the organism, temperature, hydrogen-ion concentration, partial pressures of dissolved gases, and other factors are kept within bounds. The stability that is maintained is, itself, a dynamic process, like a man walking a tight-rope. Any variation imposed from without constitutes a "stress" to which the organism reacts. The reaction may, itself, constitute a stress; just as a push on the side of a tight-rope walker might lead him to react and fall over on the same side.

The stresses—affronts to the stability of the living organism—fall into three categories: (1) noxious agents —living, non-living, or both, (2) deprivations—physical or psychological, or both, and (3) the stress syndrome of Selye. The latter is a complex reaction of the body involving the sympathetic nervous system as well as the endocrine system; it takes place under physiological or psychological stress.

It is the thesis of this book that, in pathology, these three categories of stress are interrelated, and that we must take account of these interrelations if we are to arrive at adequate measures of disease prevention and treatment. An attempt is made to bring together such diverse phenomena as infectious disease, deficiency disease, organic disease, and psychosomatic disease under a unified theory of pathology. But the implications of this theory go beyond the field of medicine; they spill over into the fields of education and sociology. The alert teacher will want to learn about and to ponder over this startling development.

ZACHARIAH SUBARSKY
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Stars in the Making. Cecilia Payne-Gaposchkin. 160 pp. $4.25. Harvard University Press. 1952.

Excellently written, this volume, based on lectures given for the Lowell Institute of Boston, treats a major problem in astronomy—evolution throughout the universe. Available evidence with its limitations is presented lucidly as the framework within which speculative answers to evolutionary processes are analyzed. Here is "scientific detection" exemplified.

The dramatic report begins with "The Players—Stars, and Dust and Atoms." Startling results often appear when feeble light from distant objects is squeezed for maximum information. For example, how can astronomers conclude that in interstellar space are dust clouds including both metallic and non-metallic particles about 0.000004 cm. in radius, and how can the chemical composition and velocities of invisible gas clouds be determined?

"The Scene: Pairs of Stars, Clusters of Stars, and Systems of Stars" comprises section 2. Then in section 3, "The Drama" unfolds in time and space through "The Ages of Things," "Evolution of Galaxies," and finally "The Evolution of Stars."

To review the arguments and details involved here is impossible. But the spirit of the discussion is clear from the final lines about the history of the universe: "If the imagined conditions at the beginning are beyond conception, so are those at the end—but in a different way. Fortunately it is far in the future, further than the time horizon of the past. Perhaps we are wrong in thinking that it can happen at all. Science has a long way to go yet."

Fletcher Watson
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Physics—A Basic Science, Third edition. Elmer E. Burns, Frank L. Verwiebe, Herbert C. Hazel, and Gordon E. Van Hooft. 546 pp. $4.12. D. Van Nostrand Company. New York. 1954.

This third edition of a good high school physics text book has been so thoroughly revised, rewritten, and reset as to be practically a new text. The physical appearance of the book has been improved by an attractive cover, the new two-column format makes it easier to read, and liberal use of bold face type emphasizes important words, paragraph headings, and principles.

Discussions of eighty-three short topics, each one of which might be used as a one lesson assignment, have been grouped into twenty-seven chapters in ten large units. Each topic is followed by its own projects, questions and problems. This organization makes each topic stand out prominently and helps the student to understand it thoroughly before another topic is begun.

Modern developments, especially in the fields of electricity, electronics and nuclear physics, have been included to make this an up-to-date as well as a well written and illustrated text book.

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